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OCTOBER, 19
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Since 1922, refiners throughout the world have learned to rely on the constant supply and consistent quality of Warren's Stabilized Natural Gasoline. The Warren symbol is their assurance of instant starting, higher octane, increased volatility and maximum power in their modern motor fuel.

Warren is the world's largest natural gasoline marketing organization.

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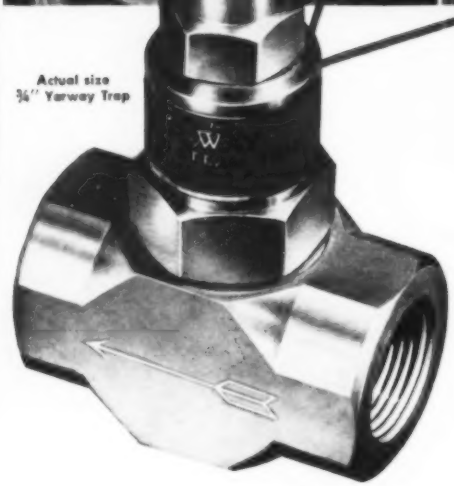

Actual size
¾" Yarway Trap

For space heating and for process work, the story is the same—Yarway Impulse Steam Traps get equipment *hotter, sooner and keep it hot!* You hear it at little plants and big plants, wherever Yarways are used.

The installation shown above is at the Ingram-Richardson Manufacturing Co., Frankfort, Ind. Here 23 Yarway Impulse Traps with Yarway Fine Screen Strainers are doing a completely satisfactory job on Unit Heater installations, finned pipe heaters and pickling tanks.

Yarway Impulse Traps discharge *continuously* under heavy loads, *quickly* bringing equipment to operating temperature. Then they keep equipment at *peak efficiency* by discharging condensate at *short intervals*, rather than waiting for quantities of it to collect.

Other Yarway advantages—small size, easy maintenance (only one moving part), good for all pressures without adjustment, low cost.

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YARWAY IMPULSE STEAM TRAP

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THE GULF PUBLISHING COMPANY

Box 2608, Houston (1), Texas

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for the refining-natural gasoline industry

WORLD OIL (formerly The Oil Weekly)
and The COMPOSITE CATALOG
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PETROLEUM REFINER

Specialized for Refining, Natural Gasoline and Petrochemical Engineering, Operation and Management

R. L. DUDLEY, President **A. L. BURNS, General Manager**

VOLUME 28, NO. 10 **October, 1949**

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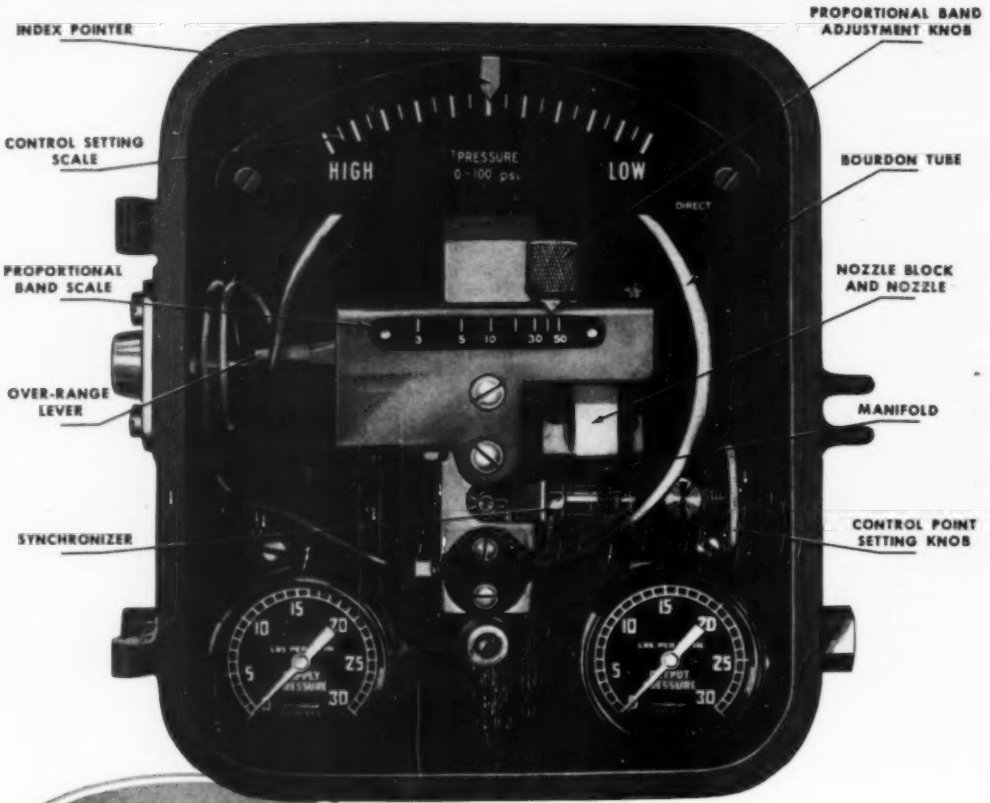
TWO MASONEILAN



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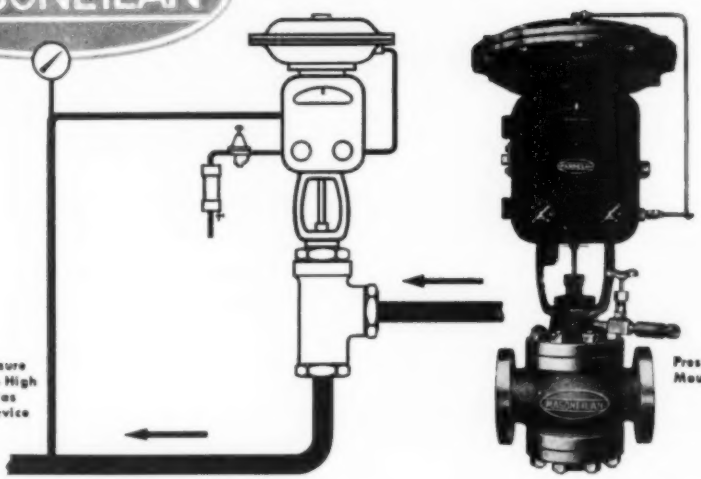

Typical Pressure Application — High Pressure Gas Reducing Service

Pressure Controller Mounted on Valve

CONTROLLERS...

That Provide Precise Control at Moderate Cost

In a Majority of Pressure Applications
In Many Temperature Applications

No. 2700 Pressure Controller

No. 3700 Temperature Controller

The majority of industrial pressure control applications and many temperature applications can be satisfactorily handled by a simple pneumatic proportional controller with narrow-to-intermediate proportional band setting. Models 2700 Pressure and 3700 Temperature Controllers have been designed to meet these requirements at moderate cost without sacrifice of performance, precise proportional response or ease of adjustment.

The pressure and temperature controllers incorporate the same basic mechanism. The design is rugged and compact. A direct non-relay type pilot is utilized for simplicity. The control point setting mechanism provides extreme accuracy of adjustment and at the same time an easily read expanded index scale.

Pneumatic feedback, usually found only in the more elaborate instrument type proportional controllers, has been included to secure the precise response which is the most essential ingredient of a controller. This simplified feedback mechanism eliminates the necessity of complicated linkage systems usually employed for adjustment of the proportional band.

The controllers are furnished in two case styles: a projecting case for valve or wall mounting; and a flush case for panel mounting. A wide selection of pressure and temperature ranges is available.

Note These Mason-Neilan Features

1. Same basic control mechanisms for pressure and temperature instruments insure simplicity, permit standardization of parts.
2. Pneumatic feedback — usually found only in more expensive proportional controllers . . . . precise response.
3. Control point setting mechanism provides extreme accuracy of adjustment and easily read expanded index scale.
4. Proportional band adjustment between 3 and 50%.
5. Compact and sturdy case and internal mechanisms; all important internal parts of bronze, brass or 18-8 stainless steel.
6. Control action reversible with either bourdon or bellows.

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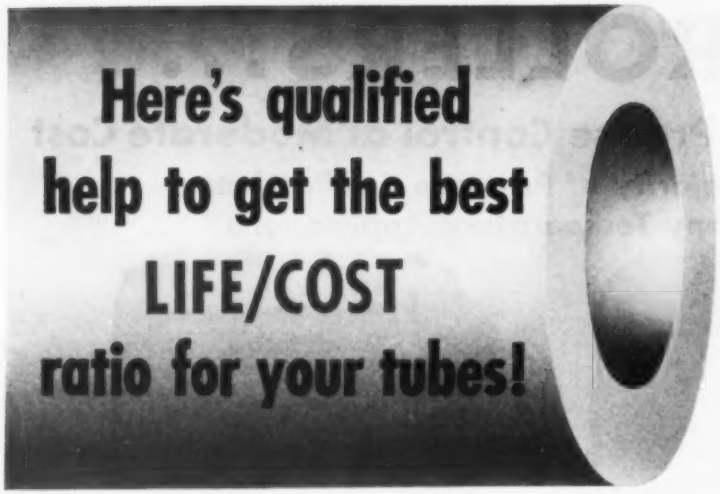
Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Philadelphia • Houston • Denver Pittsburgh • Cleveland • Cincinnati • Tulsa • Atlanta • Los Angeles • San Francisco • Salt Lake City • El Paso • Boise Albuquerque • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

Here's qualified help to get the best LIFE/COST ratio for your tubes!



TO be sure of getting the best life/cost ratio from your tubes, you need more than just any steel that answers your particular problems of heat, pressure, corrosion or oxidation. You want the *one specific steel* that gives you all this at the lowest possible cost in terms of service per dollar invested!

That's why it will pay you to call in qualified assistance to help you make your selections.

Metallurgists of The Timken Roller Bearing Company are recognized authorities on high temperature tubing applications. They are backed by 19 years of experience and research. From a wide selection of Timken* fine alloy steels they will select the correct tubing to give you the most efficient and economical performance for your specific job.

And when the correct analysis has been selected, you can be sure of this: Because of rigid quality control by Timken at every step in production, you'll get the same uniform characteristics and the same high quality in every shipment you order.

The Timken Technical Staff will be glad to study your high temperature tube problems at any time, without obligation. Write for your copy of our booklet, "Facilities and Products". The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN 18-8 STEEL TUBES Shows the best combination of creep strength, oil corrosion and oxidation resistance up to 1500°F.

TIMKEN SICROMO 9M STEEL TUBES This steel possesses the maximum corrosion resistance of any of the steels below the stainless group.

TIMKEN SICROMO 7 STEEL TUBES For applications requiring better corrosion resistance than can be obtained with 5% Chromium type steels.

TIMKEN SICROMO 5 S STEEL TUBES For oxidation resistance to 1500°F. Good creep strength and corrosion resistance to 1300°F.

TIMKEN 4-6% CR MO STEEL TUBES For service up to 1200°F. Superior corrosion resistance. Less oxidation resistance than Sicromo 3.

TIMKEN SICROMO 3 STEEL TUBES For service up to 1200°F. Have excellent oxidation resistance and good corrosion resistance.

TIMKEN 2¼% CR-1.0% MO STEEL TUBES For service up to 1150°F. Has greater resistance to creep than 2% Cr. ½% Mo. Steel.

TIMKEN SICROMO 2 STEEL TUBES For service up to 1200°F., where better scale resistance is required than can be obtained with 2% Cr. ½% Mo. Steel.

TIMKEN 2% CR-½% MO STEEL TUBES For service up to 1150°F. Intermediate corrosion resistance plus good creep strength, fair oxidation resistance.

TIMKEN DM STEEL TUBES For service up to 1150°F. This steel offers outstanding creep strength.

TIMKEN CARBON-MO STEEL TUBES For temperature up to 1000°F. Improved creep strength makes it safer than carbon steel.

TIMKEN CARBON STEEL TUBES Generally for service not exceeding 900°F., where corrosion and oxidation resistance are not important.

50th birthday of the company whose products you know by the trade-mark: TIMKEN

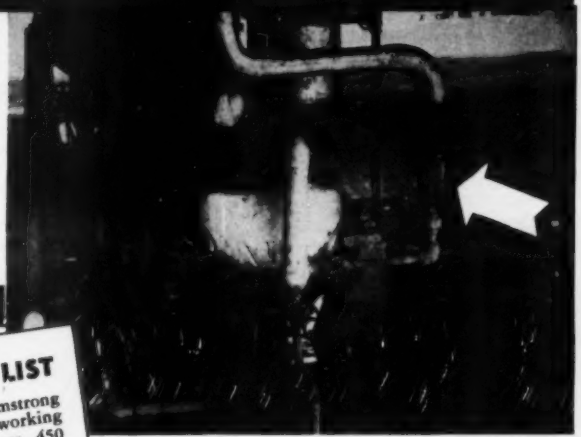
Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

Forged Steel

1. High Shock Resistance.

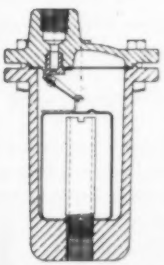
2. Bodies Will Withstand Fire.

3. The Cost Is Low.



No. 3211 — ONLY $14.00 LIST

Right—Here's the baby of the Armstrong forged steel line, a low priced trap for working pressures up to 250 psi—design pressures, 450 psi. Capacity range 750 to 1000 lbs/hr continuous. Diameter 4¼", height 7", weight 8 lbs. Available with ½" or ¾" connections. Standard Armstrong interior mechanism. Here's forged steel safety for only a few dollars more than a cast iron trap! Available for shipment from stock. Write today.



Cross-section of an Armstrong No. 3211 forged steel trap. Forged cap and body. Compressed graphited asbestos gasket. All stainless mechanism. This trap will take high temperatures and abuse without danger of fracture.

MORE and more refineries and natural Gasoline plants are using ARMSTRONG FORGED STEEL TRAPS, even at pressures as low as a few pounds. The extra safety in case of fire or an explosion more than justifies the moderate additional cost.

To use cast iron or semi-steel traps puts a weak link in the chain of steel pipe, steel fittings and steel valves. The shock of a distant explosion could fracture the cast iron traps.

Why take a chance when Armstrong forged steel traps cost so little more than cast iron?

A "standard" in high pressure power plants throughout the world, Armstrong forged steel traps are the perfect answer for extra safety and dependability in the petroleum industry. Prices are modest. For complete data, send for your copy of the ARMSTRONG STEAM TRAP BOOK.

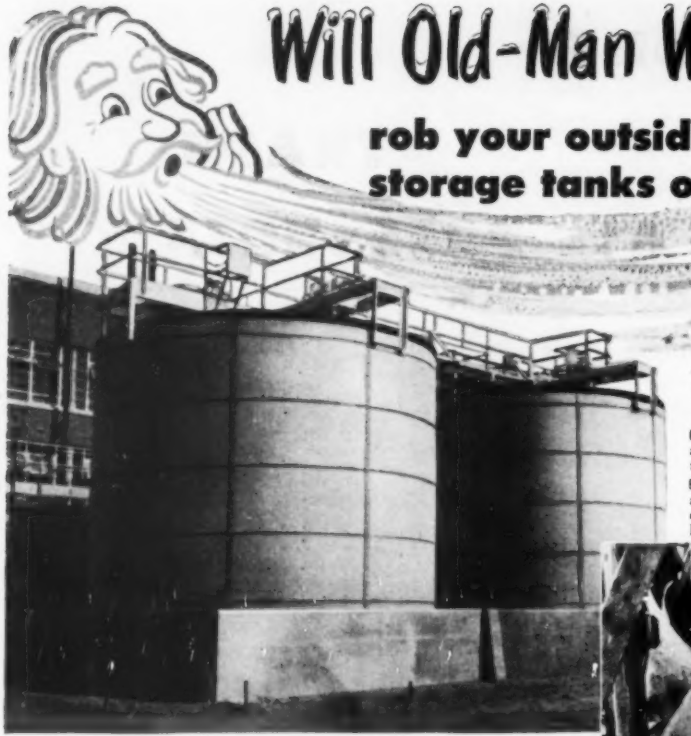
ARMSTRONG MACHINE WORKS
852 Maple St., Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

Factory Representatives in 48 Key Cities... Traps Stocked at 147 Points

Will Old-Man Weather...

rob your outside storage tanks of costly Btu's?



Left: These neat-appearing, insulated tanks are weather-protected by the Johns-Manville specification described here.

Below: Applying J-M Asbestocite (asbestos and cement sheets that are weather- and corrosion-resistant) over standard J-M Insulations.

... Here's how Johns-Manville can help you save fuel costs . . . maintain temperatures of externally stored fuels and chemicals . . .

IF YOU HAVE OUTDOOR tanks and vessels... and are heating or cooling them it will pay you to look into the Johns-Manville Weather-Protected Insulation specification.

Weather-Protected Insulation pays even though outdoor storage tanks are operated at moderate temperatures—because wind and other weather conditions can greatly affect tank temperatures. Savings, for example, on a standard fuel storage tank operating at 130 F maintained temperature can be as much as 200 Btu/sq. ft./hr.

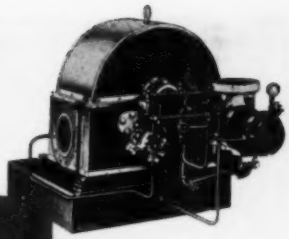
Basically, this Johns-Manville Weather-Protected Insulation specification consists of standard J-M insulations over which is applied Johns-Manville Asbestocite (asbestos-cement sheet) to protect the insulation from the weather. Shielded in this manner, the insulation pays dividends in fuel savings for many years.

If you wish, a Johns-Manville Insulation Engineer will be glad to survey your outdoor equipment to estimate fuel savings for you. Or, for more details send for a copy of folder IN-121A. Johns-Manville, Box 290, New York 16, New York.

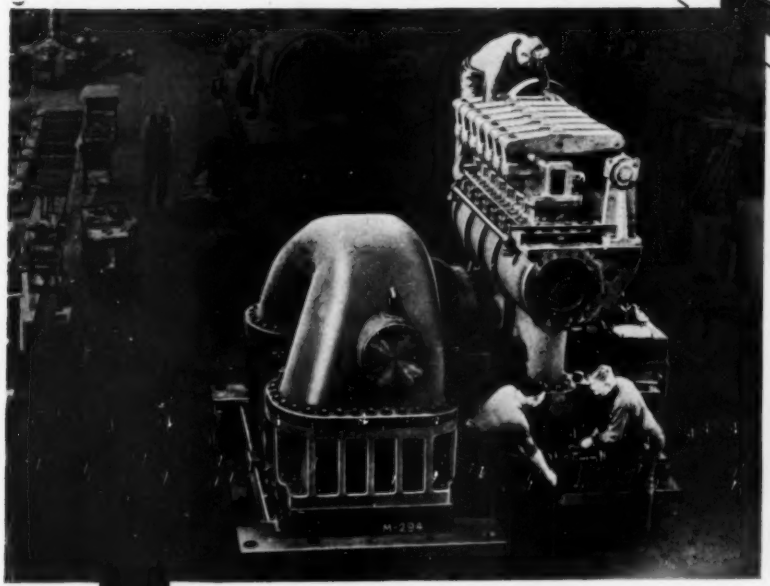
JM

Johns-Manville *First in* **INSULATIONS**

Compact, sturdy, dependable. A Worthington single-stage, centrifugal compressor-drive turbine.



FROM SMALLEST SINGLE-STAGE



TO MULTI-STAGE GIANTS

A standout for size. One of two Worthington 24,000 hp centrifugal compressor-drive turbines during assembly.

Worthington Turbines Meet the Broadest Range of Drive Requirements

Worthington Turbines offer you unlimited choice of sizes and types — including straight condensing, straight non-condensing, extraction, mixed pressure extraction, low pressure and high back pressure. Steam or gas driven, for mechanical or generator drive, all are available with governors for constant or variable speed, with optional governor-control.

LOWER-COST BLOWER AND COMPRESSOR OPERATION

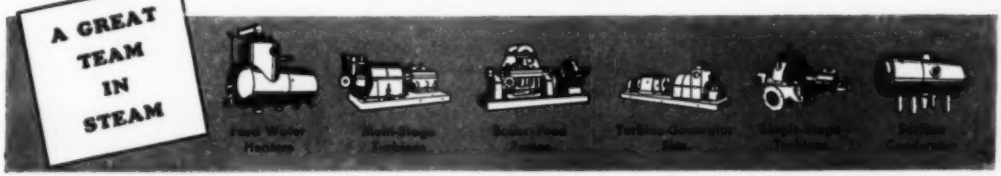
In the complete Worthington line you'll find the *right* speeds and horsepowers to keep your blowers, compressors and other mechanical drives operating at peak efficiency. And since each Worthington Turbine — from the smallest to the largest — is designed to make steam do more work, you can count on steady power- and money-saving throughout a long, trouble-free service life.

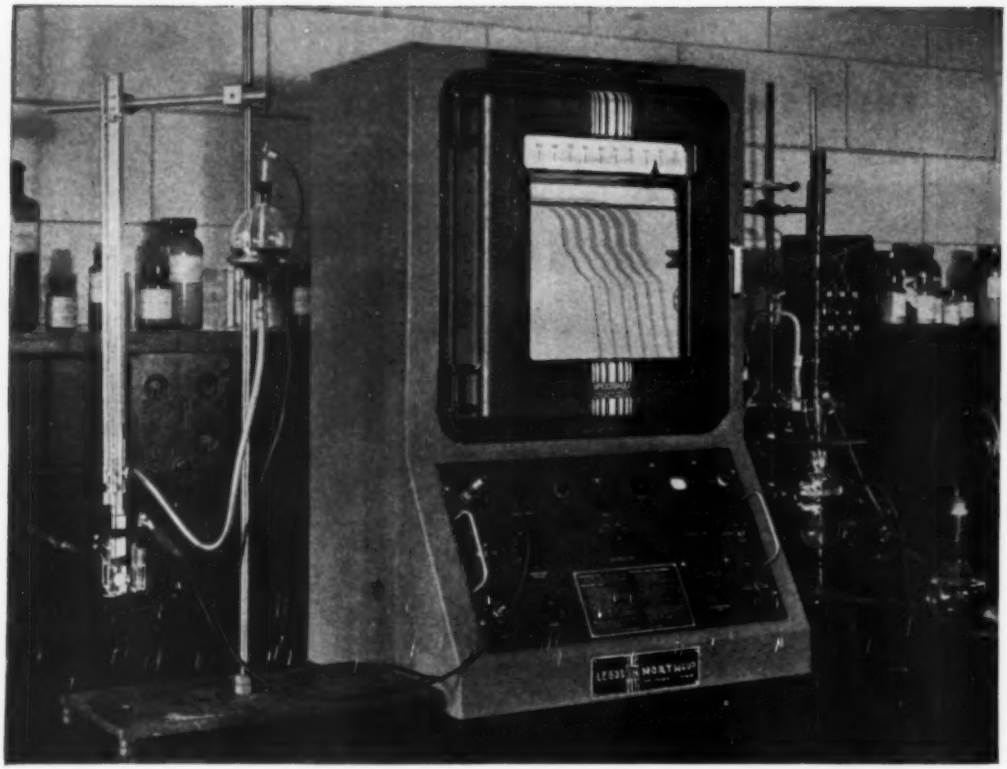
Get the whole story of this economical, always dependable power from your nearest Worthington representative. Or for further facts proving *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

T9-1





Fast, precise polarographic analysis with new Type E Electro-Chemograph

Designed for rapid, accurate polarographic analysis, the new L&N Type E Electro-Chemograph features one-piece console design incorporating a built-in Speedomax Recorder. Exceptionally flexible and stable, the instrument is convenient for both research and industrial process control laboratories.

Like the previous model of this L&N equipment, the Electro-Chemograph automatically plots diffusion current as a function of voltage. Now, however, the data-taking is done by a Speedomax Microampere Recorder, which provides greater speed of analysis and more complete detail of test results. A typical test run can now be made in about half the previous time.

A full range of variation in test technique is available through a set of controls, all centralized on one panel. Step-by-step instructions for operation, testing and calibration are included on the front of the instrument.

Choice of four degrees of damping enables the user to obtain a record that presents qualitative and quantitative data in the desired detail. Eleven current ranges cover full-scale readings of 1, 2, 3, 5, 7, 10, 15, 20, 30, 50 and 100 microamperes.

There are three polarizing voltage ranges: 0 to —2, —1 to —3 and +1 to —1 volts. To cover both anodic and cathodic polarization, any of these ranges can be reversed in polarity. Time to run through a polarizing range is ten minutes. Voltage can be adjusted to ±4 mv by calibration against an integrally-mounted standard cell.

When it is desirable to obtain several different diffusion current curves on the same chart for inter-comparison, the recorder zero can be readily shifted to separate the individual curves.

The equipment is shielded against electrical pick-up, and is not affected by vibration. Normally it is supplied for a-c operation, but it can be supplied for use with a battery for the polarizer.

For further details, write to Leeds & Northrup Company, 4923 Stenton Avenue, Philadelphia 44, Pa.

LEEDS & NORTHRUP
MEASURING INSTRUMENTS · AUTOMATIC CONTROLS · TELEMETERS
HEAT-TREATING FURNACES

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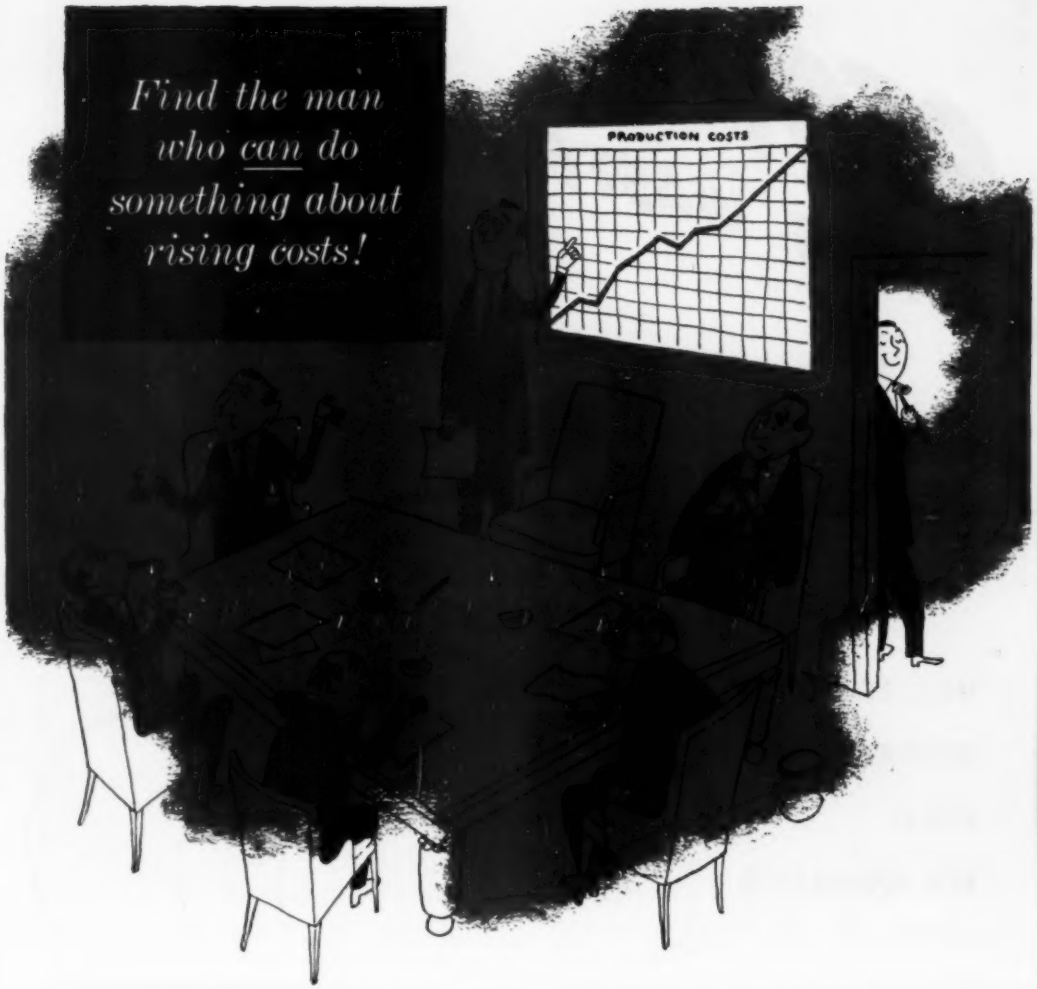
Find the man who can do something about rising costs!



In most businesses, operating costs are still on the rise. But there's *one* man who *can* do something about it—he's the man whose job is to get maximum heat and power from fuel dollars. He knows you *get* maximum efficiency from Eagle-Picher Industrial Insulations because they're made of durable, chemically and physically stable *mineral wool*, noted for its low conductivity. They give long years of service and are easy to maintain and replace.

There's an Eagle-Picher insulation that can help reduce *your* operating expenses!

Let these Eagle-Picher products also save you money . . . power . . . time

Insulating Felts
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Loose Wool • Pipe Covering
Stalastic • Insulseal • Insulstic
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Insulating Cements

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

Since 1843

STOP WASTING "WASTE" WATER

USE IT FOR

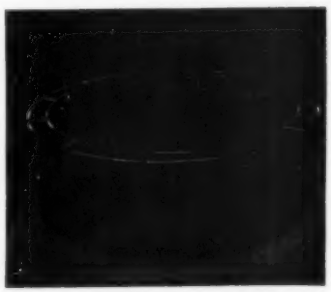
BOILER

FEED

OR COOLING

You are pouring dollars down the sewer when you fail to reclaim "waste" water that might otherwise be used over and over again. In most cases this so-called "waste" water can be used as boiler feed or for cooling with a drastic reduction in your water bill and a simplification of your disposal problem.

Let Graver analyze your "waste" water problem today. Let Graver show you how the Reactivator (shown at right) will soften and clarify this water to a point where "waste" treatment becomes a profitable operation. Employed in connection with other Graver water conditioning units . . . pressure filters and ion exchange softeners . . . the Reactivator will produce boiler feed and cooling water at lowest possible cost.



GRAVER WATER CONDITIONING CO.

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VESSEL DIVISION

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International Division: Milwaukee 1

NEW BULLETINS: Write the nearest A. O. Smith office listed above for these new Bulletins: V-44—Field Assembly of Pressure Vessels; V-46—SMITHway Vessels, Alloy, Alloy-Lined, Clad, and Glass-Lined.

BY WATER AND RAIL. A. O. Smith ships pressure vessels for the petroleum, paper, and process industries. The SMITH-lined Fractionating Tower above, one of the largest shop-fabricated vessels ever built (16 ft. diameter by 116 ft. long, weighing over 320,000 lbs.), is going by barge to an oil refinery in the Chicago area.

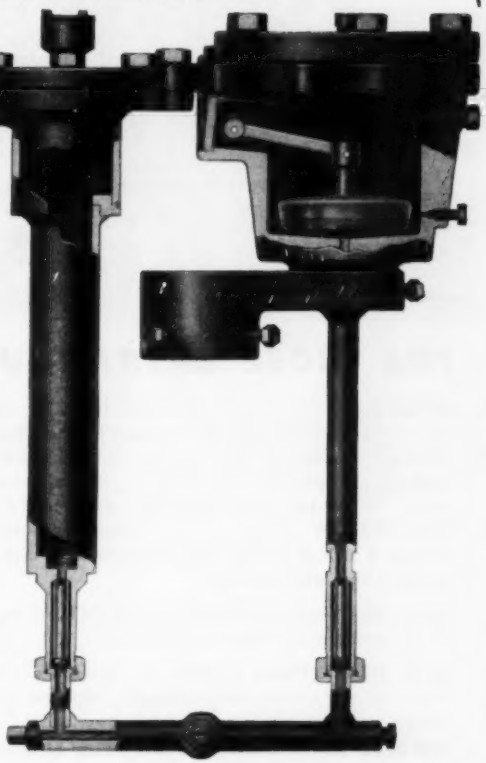
SOME 60 SMITHway PRESSURE VESSELS for both low and high temperature service have been ordered during the last four years by one company to equip two new plants. This SMITHway Tower, three railroad cars long, 116 ft. by 7 ft., weighing 137,000 lbs., is one of the types of vessels furnished.

THIS MAN KNOWS HIS CURVES: For 23 years, Frank Hilke has been shaping, to exact diameters, the shell courses of SMITHway Pressure Vessels. He uses a variety of rolls which can produce any diameter needed for pressure vessels.

RECORDING CONTACT RESISTANCE AS LOW AS 1/1,000,000 OHM. Intensive research into the surface resistance of various alloys of different finishes and thicknesses has played an important part in the development of the A. O. Smith process of resistance welding alloy linings to carbon steel backing. This SMITH-built instrument was designed to measure the various resistance properties of the alloy linings and is a valuable tool in the control of the quality of A. O. Smith resistance welding.

1 Seamless and Welded — B&W makes both.
2 Full range of austenitic and ferritic stainless steels available.
3 Sizes up to 8⅝" O. D. and a wide choice of finishes.
4 Special analyses, sizes, gauges, and lengths.
5 Nationwide availability—through B&W offices and distributors all over the U.S.A.
5
Reasons why
B&W STAINLESS TUBING
answers your petroleum processing requirements
MOST ECONOMICALLY
unbiased assistance in choosing the grade of stainless tubing that will give you the best possible service-to-cost ratio on each application, plus the convenience of a single source of supply for all stainless tubing needs.
B&W SEAMLESS and WELDED TUBES
THE BABCOCK & WILCOX TUBE COMPANY
GENERAL OFFICES: BEAVER FALLS, PA. PLANTS: BEAVER FALLS, PA. AND ALLIANCE, OHIO
TA-1457 5

"Joe—You can't beat this Taylor Mercury Manometer for performance. There's no seizing — thanks to TEFLON BEARING"



SATISFIED customers tell us the "Teflon" Pressure-Tight Bearing makes the new Taylor Mercury Manometer seize-proof and practically leak-proof. It's ideal wherever you need something *better* than present differential pressure measuring instruments. Teflon is a synthetic plastic that minimizes friction and eliminates seizing common to metal-to-metal bearings. It resists corrosion because of unmatched chemical inertness. That's why this Taylor Manometer ends pressure-tight bearing troubles that may have blocked precise control for years. Other features:

1. Great Power—thanks to extra-big float with extra-long travel. Micro-inch finished shaft with Teflon bearings "float" this power right through to the pen.

2. High Accuracy—inherent straight-line calibration.

3. Positive Actuation—high energy output. **(a) Big 3 5/16" float. (b) Long float travel—1". (c) Simple lever system. (d) Teflon in pressure-tight bearing surfaces** for efficient use of power. **(e) Jewelled thrust bearing.**

4. Dependable Performance. (a) Submerged check valves give positive shut-off. **(b) Unique damping valve** adjustable under full pressure without leakage. **(c) Ample room** in mercury chambers to accommodate surges or pulsating flows. **(d) Teflon holds pressure,** yet lets shaft turn freely, giving long service.

5. Great Adaptability. (a) Six interchangeable range tubes: 10", 20", 50", 100", 200" and 400" of water. **(b)** All ranges except 10" may be over or under ranged 33⅓%. **(c)** Both side and top pressure connections. **(d) Two manometers** can be mounted on back of single case for recording two Flows or for Ratio-Flow control. **(e)** A union coupling prevents distortion of bearing housing—eliminates binding or friction caused by wrench-torque.

6. Ease of Maintenance. (a) Low pressure chamber cover permits easy access to float and lever arm during calibration. **(b) Entire pressure-tight bearing** easily and economically replaced.

Ask your Taylor Field Engineer, or write for bulletin 98182. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

FOR THOSE "*EXTRA TOUGH*" WATER COOLING JOBS

MARLEY DOUBLE-FLOW COOLING TOWERS are built to "Take It"! For unusually heavy water cooling requirements . . . open, closed or combination cooling . . . in any kind of weather . . . and in abnormally corrosive atmospheres, the MARLEY DOUBLE-FLOW is designed to give consistent, around the clock service with a minimum of maintenance time and expense.

This is true because MARLEY DOUBLE-FLOW has these outstanding, exclusive features:

OPEN DISTRIBUTION SYSTEM . . . On top of the tower, in plain view, easy to inspect, regulate and clean.

NO DEAD AIR POCKETS . . . Every drop of water meets a steady flow of air as it splashes down thru Marley's patented nail-less filling.

BETTER MECHANICAL EQUIPMENT . . . Equipped with Marley engineered and Marley made fans, fan cylinders, drive shafts and Geareducers . . . your assurance of top quality.

SOUND STRUCTURES . . . Double-Flows have withstood hurricanes, earthquakes and corrosive atmospheres because all lumber, hardware, supports, bracing and columns are designed to make an engineered structure.

COMPLETELY SAFE OPERATION... Stairways, handrails, walkways, and fan cylinders insure safe operation and maintenance in any kind of weather.

MINIMUM DRAFT LOSS . . . Drift eliminators set in slanting position allow greater area for air passage, minimizing draft loss and reducing horsepower requirements.

GREATER COOLING CAPACITY . . . Packed with decks of nail-less filling, Double-Flows have more wetted surface therefore greater cooling capacity.

If you're looking for GREATER SERVICE, LOWER COST and IMPROVED WATER COOLING EFFICIENCY in your plant, be sure to ask a MARLEY "Double-trained" APPLICATION ENGINEER to analyze your situation and recommend the COOLING TOWER you need to meet your requirements. There's no cost or obligation.

Photo by Elwood Payne

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

WATER COOLING TOWERS · DRICOOLERS · SPRAY NOZZLES

For a processing problem like this...

"...severe corrosive conditions resulting from high sulphur content of sour crude oils..."

NATIONAL TUBE might recommend:

ANALYSIS No. 12*

Type of Steel—5 Chromium, ½ Molybdenum

In equipment involving severe corrosive conditions such as processing of very sour crude oils containing large amounts of sulphur, only the higher chromium compositions, such as 5% Cr, .5% Mo stabilized or the 18-8 alloys are recommended.

FINDING the answer to refinery tubing problems isn't always as easy as the above instance might indicate. But when NATIONAL does come up with a recommendation, you can depend on it being the best possible for your particular case.

How can we justify such a statement? Because we study conditions as they actually exist in your plant (usually from what you tell us; sometimes by sending a tubing specialist for a personal observation). We then check the information thus obtained against our large and growing file of past problems involving similar conditions which have been successfully solved with NATIONAL Seamless Pipe and Tubes. That's how NATIONAL developed many of the *25 different* analyses of Still Tubes, Condenser and Heat Exchanger Tubes, and Refinery Piping which we now offer the industry. We call it our "Complete Tube Service."

We invite you to bring your problems to NATIONAL. It's the easy, proven way to select the *proper* refinery tubing for your plant. An inquiry entails no obligation . . . and our recommendations may solve your problem.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.
(Tubing Specialties Division)
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL TUBE offers you

Seamless Steel Still Tubes · Condenser Tubes
Heat Exchanger Tubes · Refinery Piping in

25 DIFFERENT ANALYSES

- Low Carbon
- Low Carbon, ½ Moly.
- Low Carbon, 1 Moly.
- ½ Cr., ½ Moly.
- 1¼ Cr., ½ Moly.
- 2 Cr., ½ Moly.
- 2 Cr., ½ Moly., 1¼ Sil.
- 2¼ Cr., 1 Moly.
- 2½ Cr., ½ Moly., ¾ Sil.
- 3-Cr., ½ Moly., 1¼ Sil.
- 3-Cr., 1 Moly.
- 5-Cr., ½ Moly.
- 5 Cr., ½ Moly., 1½ Sil.
- 5 Cr., ½ Moly., Titanium
- 5 Cr., ½ Moly., Columbium
- 7 Cr., ½ Moly.
- 8 Cr., 1 Moly.
- 9 Cr., 1 Moly.
- 12 Cr., Aluminum.
- 17 Cr.
- 18-8
- 18-8 Titanium
- 18-8 Columbium.
- 18-8 Molybdenum.
- 25-20

WELDS WITHOUT WELDS

USS

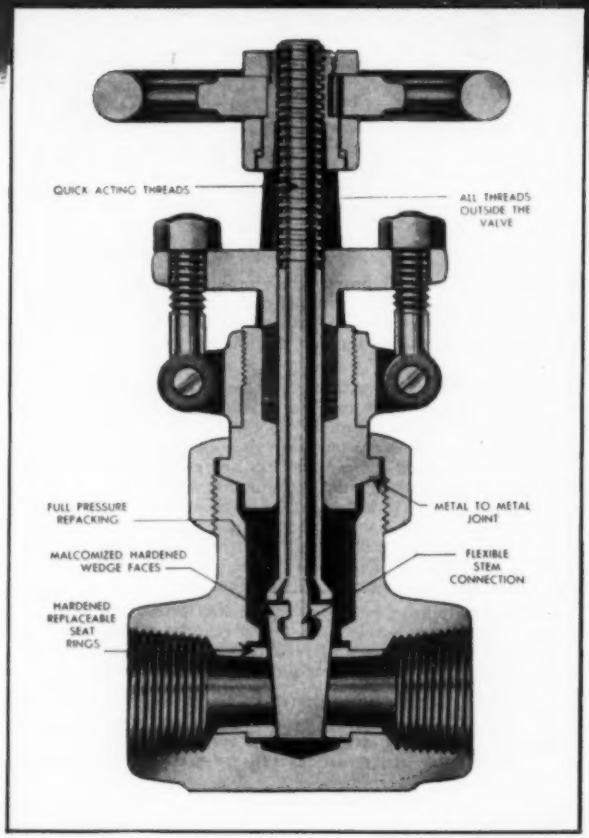
NATIONAL SEAMLESS PIPE AND TUBES

UNITED STATES STEEL

You Can Repack this

CHAPMAN LIST 960

UNDER FULL PRESSURE

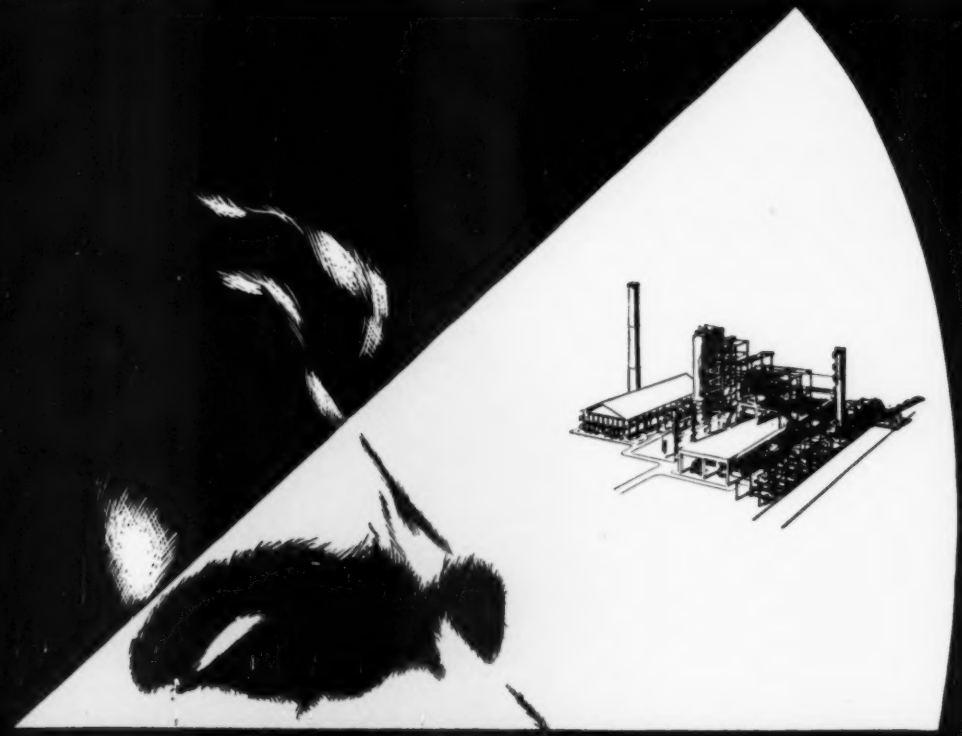


Here's a rugged, small gate valve you can repack right while it's in use . . . no pressure is transmitted to the stem. Use it in exposed locations, too, for a forged steel packing gland protects the vital yoke threads against rust and corrosion. A recent design feature gives stem and wedge gate connection a more than 50% increase in strength . . . extra protection against even the most extreme operating conditions.

Made in sizes from ¼" to 2" — carbon steel for pressure range 2000 pounds at 100° F., 380 pounds at 1000° F. For higher pressures, specify List 990.

The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASS.



perspective

Perspective in plant design and engineering calls for matching progressive engineering with economic foresight. We cannot predict the future, but we *can* recognize that the economic balance for a plant or process never stays put. We in Lummus do our best to look at your plans from past, present and future points of view.

Our perspective has paid off in plants of exceptional operating flexibility—able to make a profit in spite of wide swings in demand.

LUMMUS designs and builds with **PERSPECTIVE**

- economy
- fulfillment
- resourcefulness
- teamwork
- technique

perspective

In planning this French refinery, both its initial operating level and its ultimate, expanded capacity were guiding factors for design. Room was provided for the easy addition of filters, double pipe chillers and refrigeration equipment, to double the capacity of the unit in this respect. An efficient plant today, it will be equally efficient tomorrow, because expansion need never be "makeshift."

perspective

Lummus catalytic cracking plants, war-built for 100-octane gasoline, are being operated to produce motor gasoline of lower octane rating on a consistent low-cost basis. Their suitability for this latter service was attained without any compromise in design for their original purpose. Rather, the Lummus-engineered design had the flexibility to meet requirements for the efficient production of either fuel.

perspective

The interest of Lummus in any of its installations does not end with construction and initial operation for customer acceptance. Periodic visits by Lummus field representatives are continued to review performance. In a recent case where a radical change in product requirements arose, these operating checkups furnished valuable aid in arriving at a prompt and practical plant modification to meet the new demands.

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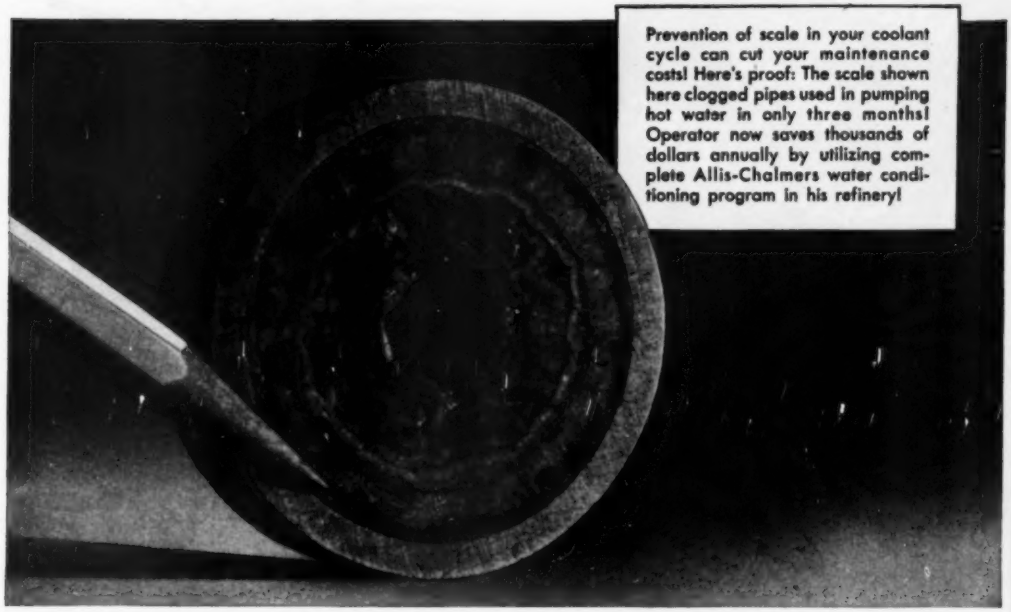
Société Française des Techniques Lummus
39 Rue Cambon, Paris 1er, France

Compañía Anónima Venezolana Lummus—Edificio "Las Gradillas"
Esquina Las Gradillas, Caracas, Venezuela

Prevent Profit-Stealing Scale in Your Refinery



Prevention of scale in your coolant cycle can cut your maintenance costs! Here's proof: The scale shown here clogged pipes used in pumping hot water in only three months! Operator now saves thousands of dollars annually by utilizing complete Allis-Chalmers water conditioning program in his refinery!

A-C SUPPLIES COMPLETE WATER CONDITIONING SERVICE—EQUIPMENT—CHEMICALS

SCALING AND HOT RUN-DOWN STREAMS can waste thousands of dollars annually in your refinery! Your master mechanic or head stillman knows your needless expenditures for excess condenser maintenance, product loss and down-time of process units.

Allis-Chalmers does not offer a "cure-all" for the scaling problems in any coolant cycle. We recognize that every problem is different—depending upon raw water analysis, per cent of make-up, etc. After a careful study of all the factors involved, A-C specialists can recommend an efficient process or equipment for your particular needs:

SERVICE: Complete analysis of water supplies; reports on water-steam cycle; study of equipment; advice on selection of chemicals; periodic reports and service calls.

CHEMICALS: Scale inhibitors for all heat exchanger cycles. Special chemicals to prevent boiler scale, control corrosion, reduce silica, and correctly condition sludge.

EQUIPMENT: Hot and cold process softeners, sodium and hydrogen zeolite softeners, degasifiers, deionizers, chemical proportioners, oil removal and water filters.

For prompt assistance with *any* water conditioning problem, call your nearby A-C Sales Office, or write direct.

A 2791

ALLIS-CHALMERS, 1062A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

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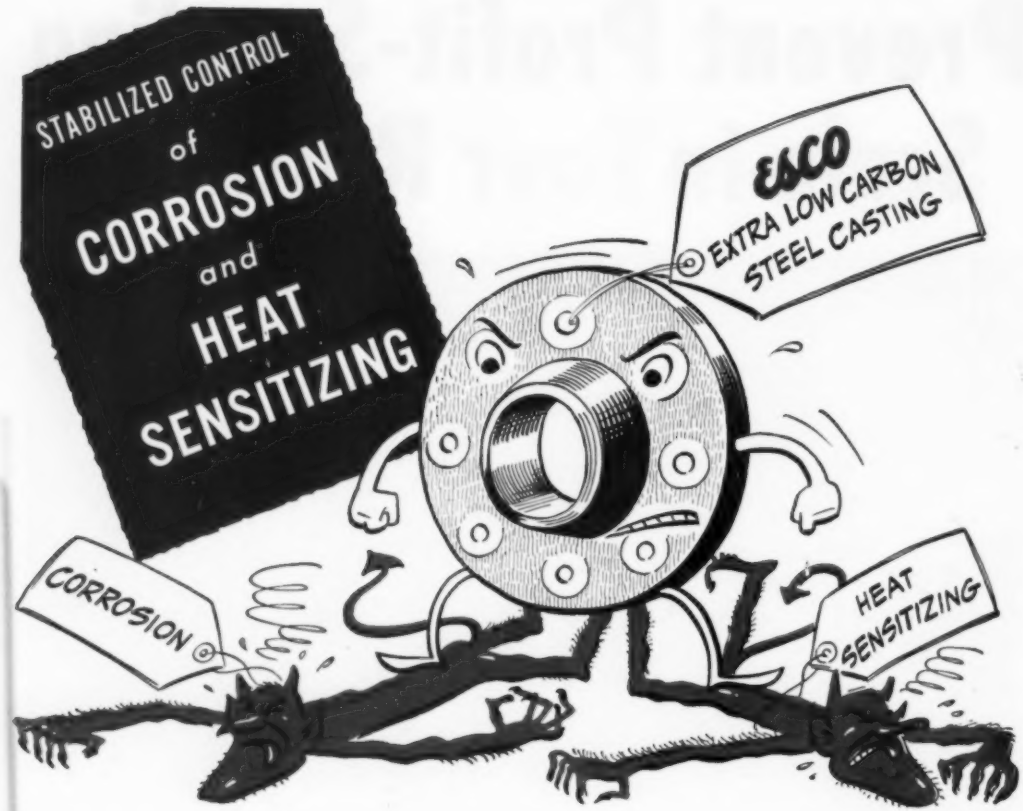

You can weld your stainless castings without subsequent heat treatment, yet retain initial effectiveness against corrosion . . . Your castings will handle materials heated to elevated temperatures without becoming sensitized . . . IF your castings are made of *ESCO* Extra Low carbon stainless steel.

With a maximum carbon content of .03%, these castings suffer a minimum of carbide precipitation when welded or heated. Initial resistance to corrosion and heat remains constant.

Perhaps an *ESCO* extra low carbon stainless steel casting will solve a problem in your plant. You are invited, without obligation on your part, to write us about it. Completely staffed engineering and metallurgical departments are available to help find a practical solution.

Literature available upon request.

Electric Steel Foundry, 2181 N.W. 25th Avenue, Portland 10, Oregon. Offices in Eugene, Oregon; Chicago; Honolulu; Houston; Los Angeles; New York City; San Francisco; Seattle and Spokane. In Canada, *ESCO* Limited, Vancouver, B.C.

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How Unit Construction Cuts Petroleum Pumping Costs

Electrifugal
PUMP
Close-coupled pump and explosion-proof motor giving dependable service in tank farm. Note that cast iron yoke and bracket for mounting pump are a single-piece — eliminating a separate adapter. Note also that both motor and pump are on a single shaft — assuring perfect and permanent alignment!
A-C

SAVES YOU MONEY THESE 3 WAYS:

- **In Installation** — Installation is easier, quicker — pump comes ready to run. No alignment problems. No extra parts. Easy to handle. Requires small space.
- **In Operation** — Pump and motor designed together to give high efficiency. Every unit tested and guaranteed.
- **In Maintenance** — Cannot get out of alignment. Has fewer parts and fewer machined fits. Bronze wearing ring protects casing from wear and is easily replaced when required.

The *Electrifugal* pump, ranging from 10 to 1600 gpm with heads to 525 feet, is just one of many types of pumps built by Allis-Chalmers for industrial service. You can depend on the recommendations of the A-C pump application engineer to give you dependable service at lowest cost. For information, see your Allis-Chalmers Authorized Dealer or Sales Office or write for Bulletin 52B6059E. A-2774

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Power, Electrical, Processing Equipment for Petroleum Industry

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SERVICE

Wilshire Installs Gas Recovery System

By M. A. Machris
Vice Pres., Wilshire Oil Company

THROUGH the installation of an improved gas recovery system as an adjunct to the UOP thermal cracking plant in our Norwalk, Calif., refinery, Wilshire has placed itself in a position to take advantage of the favorable market for LPG which presently exists in our territory.

M. A. Machris

The job was done at remarkably low cost because a considerable amount of equipment in the aviation gasoline section of the refinery, now shut down, was available.

Construction by Refinery Force

The engineers of Universal Oil Products Company worked closely with us in designing and engineering the project while the construction was done by our own forces.

To visualize the new facilities, it is necessary to describe briefly the cracking section of the refinery as it existed before the new work was undertaken.

Cracking Unit Rated 8,000 B/D

The cracking unit is of the two-coil, full flashing type, consisting of heavy and light oil heaters, a reaction chamber, a flash chamber, a main fractionating tower, a secondary column, a low pressure absorber and a stabilizer. Rated capacity was 8,000 b/d. We also have a thermal reforming unit, rated capacity 4,000 b/d, which had been shut down since the war.

As operated before revamping, the overhead from the cracking plant fractionator was split into two streams by means of a secondary fractionator. The heavy gasoline went directly to an acid treating operation, thereby precluding its use as absorbing medium in the gas recovery system. The light stream was accumulated in a receiver and from there charged to a stabilizer. The overhead from the stabilizer was delivered to polymerization after the gas was processed in a TPP unit for hydrogen sulfide removal.

The gas from the secondary tower receiver went to the low pressure absorber. The absorbing medium was a side cut from the main fractionator. The rich oil from the absorber was returned to the main column of the cracking plant and the absorber lean gas was discharged to fuel. This lean gas contained recoverable quantities of valuable P-P and B-B, all of which were burned as fuel.

The purpose of the revamping job was three-fold: 1. To increase recovery of propane and butane. 2. To obtain a salable propane fraction. 3. To remove hydrogen sulfide from the recovered gas by fractionation, thus eliminating the cost of operating the TPP unit. How

(Advertisement)

these have been accomplished is shown by the comparative analyses of the effluent gas streams before and after:

	Absorber Gas To Fuel		Poly Feed	
	Before Revamp	After Revamp	Before Revamp	After Revamp
H_2S	10.9	6.8	1.7	.2
H_2		5.2		
C_1	33.1	43.0	1.4	—
C_2	23.2	32.9	10.4	1.0
$= C_2$	9.4	6.1	14.2	16.2
C_3	13.0	5.4	22.8	25.1
$= C_3$	4.3	.1	22.7	29.6
C_4	3.8	.3	20.4	26.9
C_5	2.3	.2	6.4	1.0

Used Aviation Gas Equipment

Equipment used in the production of aviation gasoline and unused since the war furnished most of the equipment for the new facilities. Six vessels were available and five were in the immediate area. These were the reformer stabilizer, a straight run gasoline stabilizer, a natural gasoline stabilizer, a low pressure rerun column, the thermal cracker stabilizer and the thermal cracker absorber.

The low pressure rerun column was installed as a primary absorber using partially depentanized light gasoline as the absorbing medium. The old absorber was retained as a secondary absorber using a light side cut from the main column on the cracker as the absorbing medium.

The existing cracker stabilizer was converted to use as a partial depentanizer. Part of the bottoms from this column goes to the primary absorber, the remainder to storage by way of a caustic scrubber. Two streams, one liquid and one gas, are taken overhead. These streams contain the recovered B-B and P-P. The liquid stream goes to the stripping section of a high pressure de-ethanizer, which was formerly the straight-run gasoline stabilizer.

The gas portion is charged to the high pressure absorption section of the de-ethanizer, the absorber being converted from the natural gasoline stabilizer.

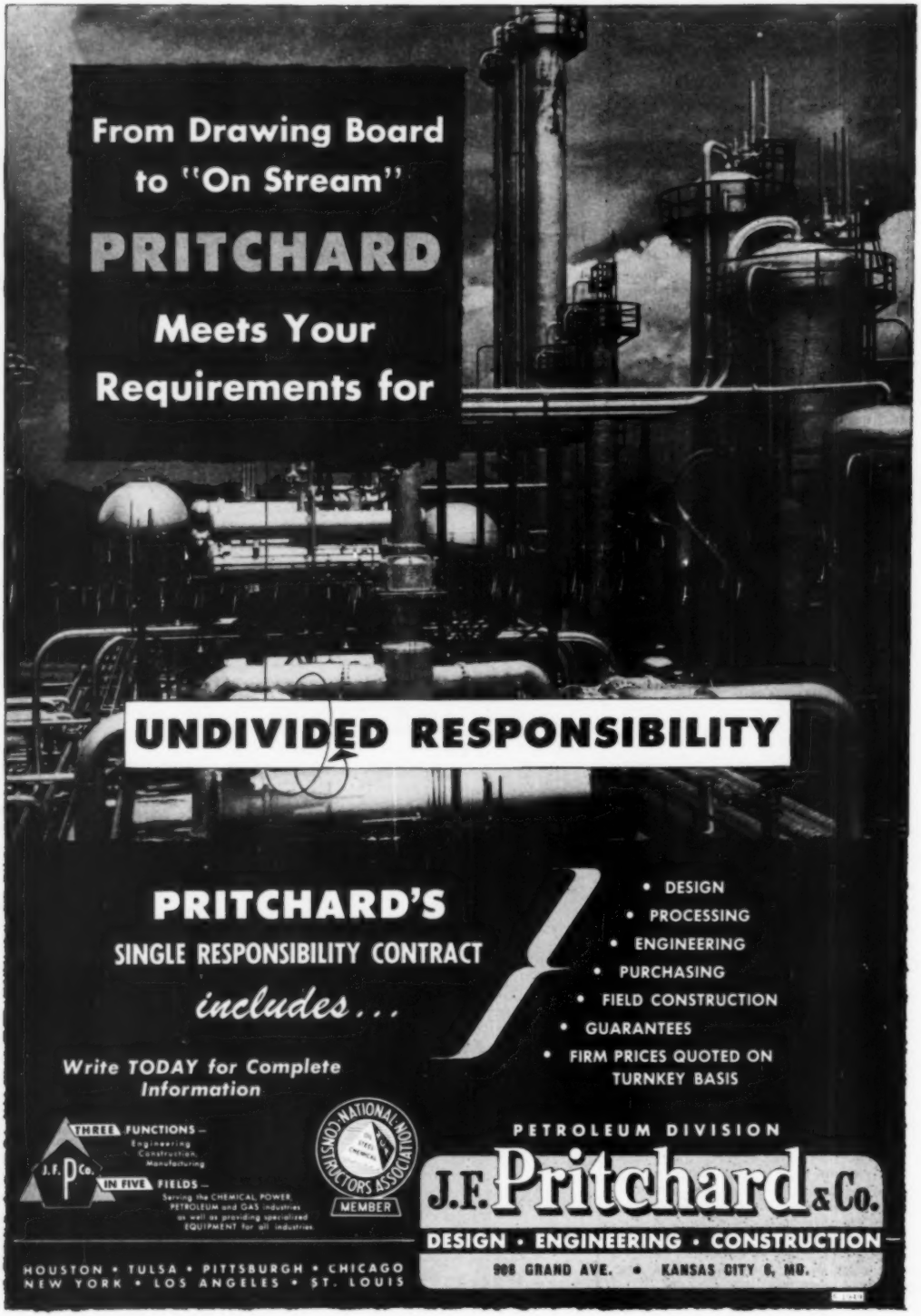
The bottoms from the stripper section containg B-B, P-P and pentanes are charged to the poly feed column, formerly the reformer stabilizer. This column in LPG manufacture, operates as a depropanizer.

Designed for Flexibility

The gas plant is designed for maximum flexibility. Thus substantially H_2S free C_2-C_4 fraction can be taken overhead in the poly feed column as charge to polymerization or the column can be operated to produce an overhead cut that is substantially propane and meeting LPG specifications. The bottoms from the column may be blended directly with refinery light gasoline or debutanized for B-B make.

While not a part of the project, Wilshire is now preparing to put back into use the hydrogen sulfide removal unit as part of an operation to rid Wilshire fuel gas of its hydrogen sulfide content. It is being undertaken in cooperation with other Southern California refiners in order to rid Los Angeles skies of smog.

(Advertisement)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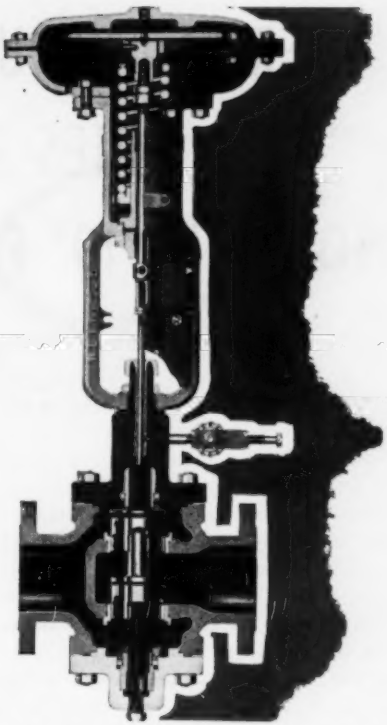
YOU GET ALL 3

with the BELFIELD "700"

Diaphragm Control Valve



1 Advanced Design

Such attractions as Premolded Neoprene Diaphragm with Rolling Action . . . Pivot-Mounted Inner Plate and Cradle-Mounted Upper Spring Flange . . . Duplex Bearings for Stem . . . One-Piece Bonnet . . . Top and Bottom-Guided Disc . . . *all in addition to the usual features you expect in a fine valve.*

2 Proved Quality

The kind of quality that provides enduring reliability with a minimum of maintenance . . . the result of more than 100 years of experience with the right design, the right material, the right specification for each and every job.

3 Nationwide Service

Every Belfield Valve is backed by the entire Minneapolis-Honeywell network of branch offices and factory-trained field engineers, as near to you as your phone.

BELFIELD MH WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL MH VALVES

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MINNEAPOLIS Honeywell — *Diaphragm Valves* AND PROCESS CONTROL SPECIALTIES — Belfield VALVES

AMERICAN REPUBLICS CORPORATION

DRIES RESIDUE GAS TO MINUS 10° F. with ALCOA Activated Alumina

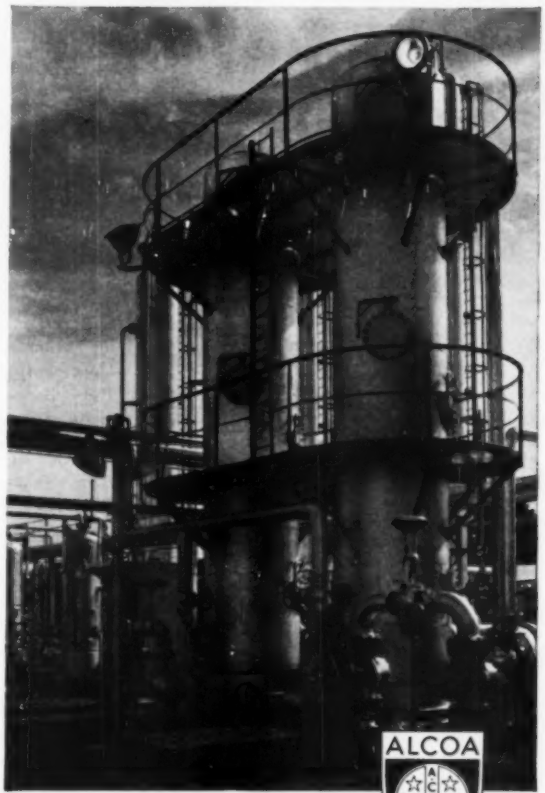
American Republics Corporation depends on ALCOA Activated* Alumina to dry residue gas at their Silsbee, Texas, gasoline plant.

Each of the two dehydrating towers, illustrated, is charged with 16,000 lbs. of ALCOA Activated Alumina. Gas, entering the towers at approximately 100° F. and 900 psig, is dried to dew points not exceeding *minus* 10° F. Approximately 15,000,000 standard cubic feet of gas passes through the towers daily. Reactivation is accomplished with natural gas heated to 375° F.

ALCOA Activated Alumina was chosen for this installation because it is *dependable* and *economical*. It can be reactivated an almost unlimited number of times, without appreciable effect on its moisture adsorption efficiency.

ALCOA Activated Alumina will readily and repeatedly adsorb moisture from vapors and gases to dew points below *minus* 100° F. without changing its form or properties. It does not soften, swell, or disintegrate even when immersed in water. Furthermore ALCOA Activated Alumina is chemically inert to most gases and liquids, and is non-toxic.

ALCOA Activated Alumina is an efficient, long-lasting desiccant, for dehydrating to dew points even below *minus* 100° F. Let us send you complete information. ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 1963K Gulf Building, Pittsburgh 19, Pennsylvania.



*Reg. T.M., Aluminum Company of America

ALCOA CHEMICALS
ALUMINAS AND FLUORIDES

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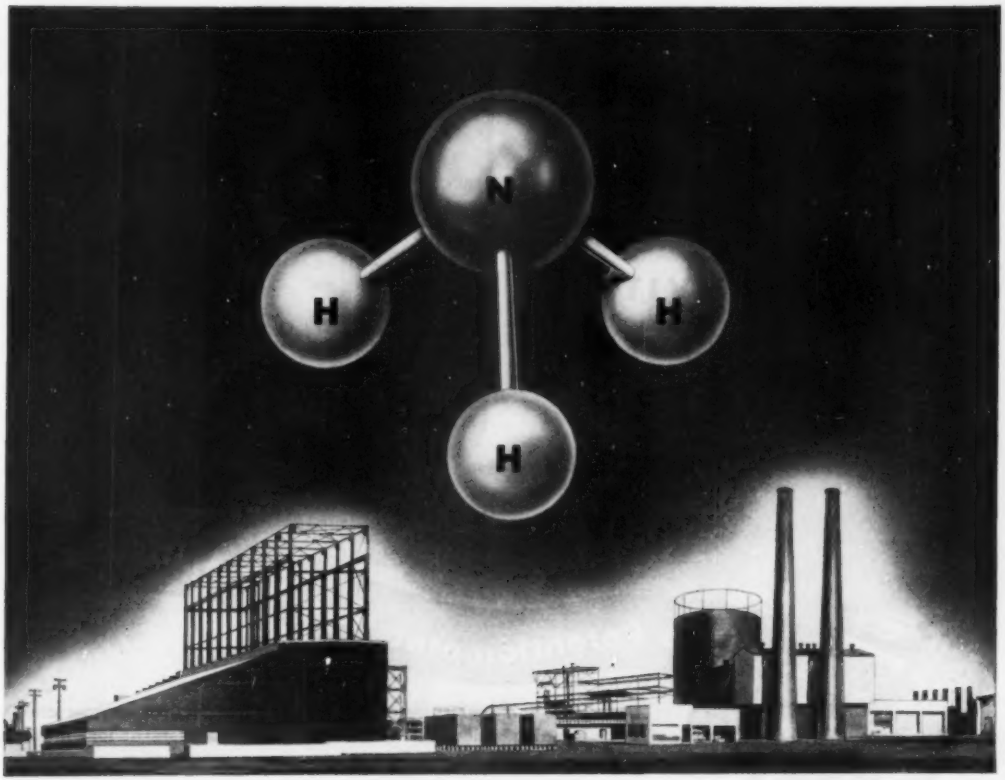
ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE



THINKING OF MAKING *Synthetic Ammonia?*

3,953 tons per day! That's the total rated capacity of 44 synthetic ammonia installations completed or currently being constructed throughout the world by Chemico. Here are four major reasons why so many large producers of synthetic ammonia look to Chemico:

1. Chemico-built plants employ the well-known N. E. C. Process which can be adapted to use any available source of hydrogen, i.e. from electrolytic cells, semi-water gas from coke and natural gas as well as from coke oven gas, gas from lignite or by-product hydrogen from electrolytic chlorine cells or fermentation processes.
2. The gases for the production of ammonia are thoroughly purified before being introduced into the synthesis system. This accounts for the continuous service and long life of the catalyst . . . important factors in assuring low ammonia costs.
3. The temperature of the highly active, extremely rugged catalyst is kept at a constant optimum. This avoids overheating portions of the catalyst mass, with a consequent loss of activity.
4. Chemico plants are designed to operate at pressures high enough to effect maximum economy, but which permit the use of conservative safety factors, high efficiencies and simple, economical designs.

No matter what your synthetic ammonia requirements . . . whether you plan to build a new plant or remodel an old one . . . it will pay you to investigate thoroughly *all* the advantages Chemico offers. Chemico's unmatched record of experience in designing and constructing heavy chemical plants is your best guarantee of profitable performance. Write today for Chemico Bulletin A-101.

CHEMICAL CONSTRUCTION CORPORATION

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CC104 CABLES: CHEMICONST, NEW YORK

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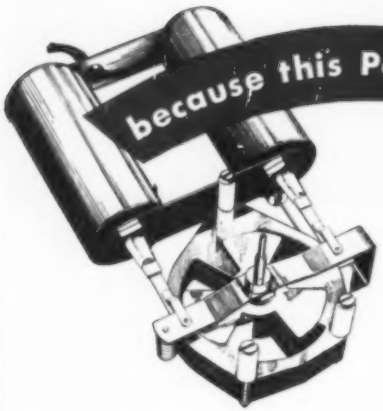
Look!

FULL SENSITIVITY EVEN ON WIDE SCALES

because this Potentiometer has NO SLIDEWIRE



Here is the heart of Dynalog Instruments . . . the "Dynapoise Drive". Its simple, variable capacitor eliminates the friction and turn-to-turn skips of the conventional slidewire.

With full sensitivity on *wide* scales (as well as narrow ones), Dynalog* Electronic Recorders and Controllers at last make it possible to select chart ranges that cover shutdowns and other process extremes. No longer is it necessary to compromise accuracy in order to get complete chart records of an entire process cycle.

The unique, radio-type capacitor of Dynalog Instruments gives them three times the sensitivity of previous instruments for the same jobs (1/100 of 1% of scale). It provides *absolutely stepless*, continuous balancing, free from turn-to-turn limitations of a slidewire.

This and many other advantages of these electronic potentiometers are results of full and skillful use of electronic methods which eliminate mechanisms found in conventional bridge-type instruments. Dynalog Instruments are available for measuring and controlling temperatures (with thermocouples or resistance bulbs), humidity, pressure, flow, force, etc. Get the complete story in Bulletin 427. Write **The Foxboro Company, 74 Neponset Avenue, Foxboro, Mass., U. S. A.**

DYNALOG* SIMPLICITY that means PRACTICALLY NO MAINTENANCE

• No slidewire • No moving contacts • No high-speed motor • No galvanometer • No standardizing • No gears or cables • No knowledge of electronics needed • Only occasional replacement of standard radio tubes required • Impossible to over-range

*Reg. U. S. Pat. Off.

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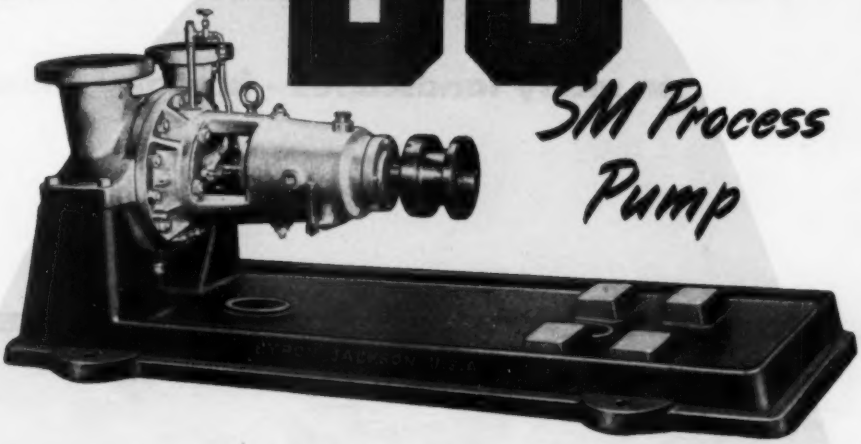
DYNALOG ELECTRONIC INSTRUMENTS

For *Hot* jobs

BJ

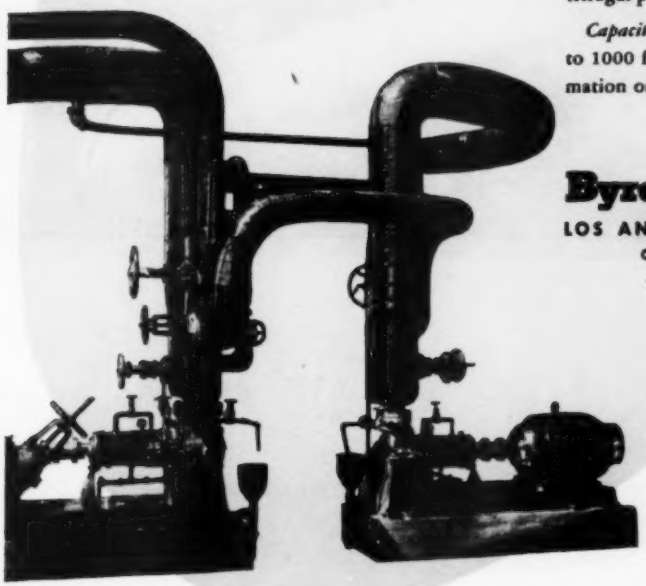
SM Process Pump



Hot, inflammable liquids...pumped under high pressures and at temperatures well above the flash point. Cold, boiling liquids . . . pumped from vacuum vessels. These and other pump problems are encountered in those industries whose products are processed in liquid form.

BJ Type SM Process Pumps are accepted as the safest and most efficient pumps used by processors for the "Hot" jobs. This is as it should be. For BJ is the leader in the development of centrifugal pumps for the process industries.

Capacities: 40 to 1200 gpm; Heads: 25 to 1000 feet. Write for the latest information on Refinery Pumps.



Byron Jackson Co.

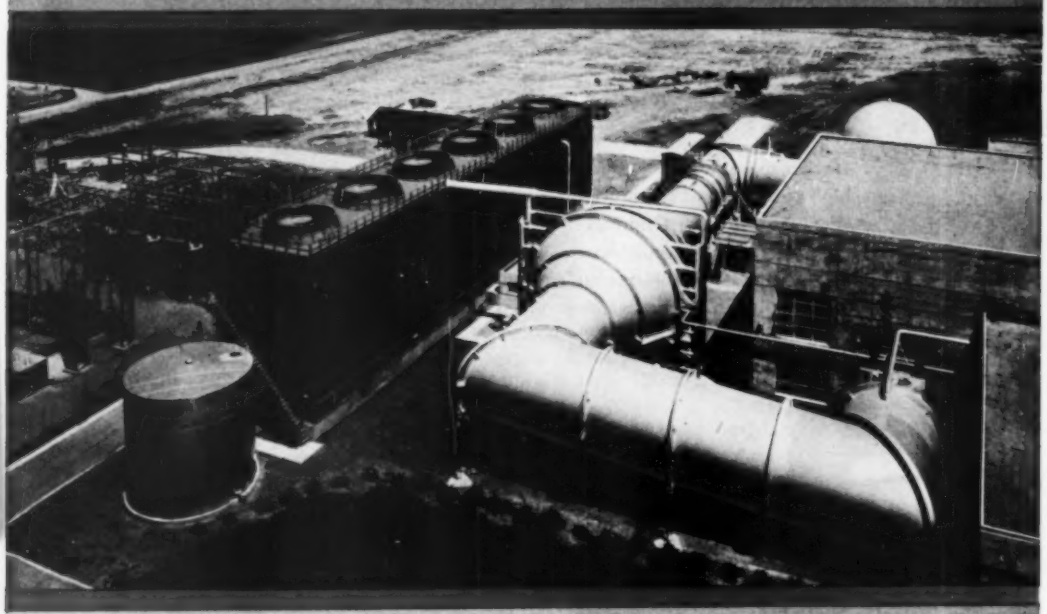
LOS ANGELES 54, CALIFORNIA

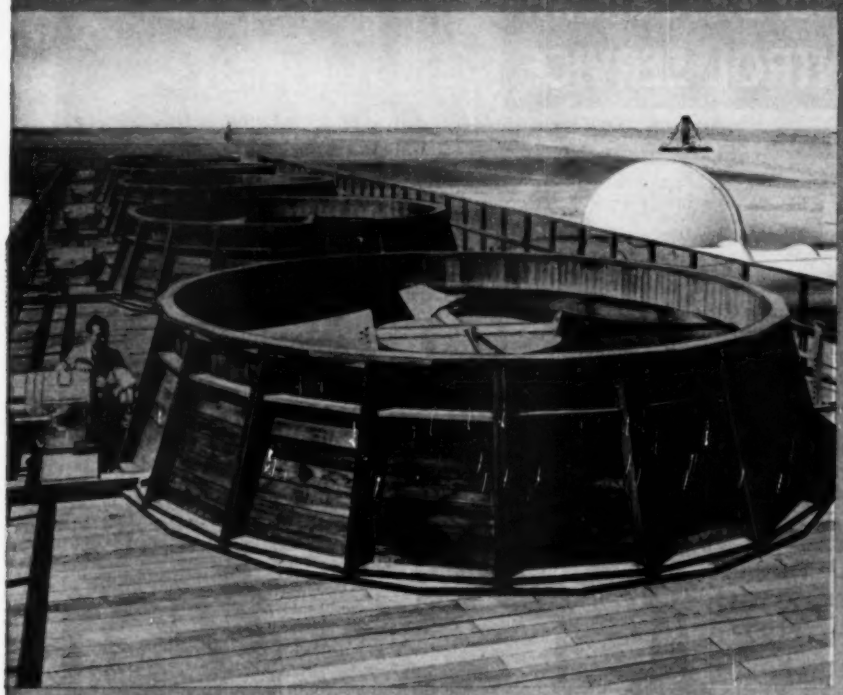
Offices in Principal Cities

Two SM Process Pumps, installed by Refinery Engineering Co. Two-stage Turbine-driven pump (left) operates against a 775 foot head, motor driven pump (right) against a 530 foot head. Pumping 28° API reduced crude at 550° F.

FOSTER WHEELER COOLING TOWERS

on many landscapes—in many climates





The cooling tower shown here serves the high speed engines operating the 6 by 6 foot supersonic wind tunnel of the NACA's Ames Aeronautical Laboratory at Moffet Field, California. It is an induced draft type of tower which was designed by Foster Wheeler engineers for high efficiency in cooling. The flexibility of this design, now standardized, enables Foster Wheeler to engineer and erect cooling towers for the requirements of any load anywhere in the world.

FOSTER WHEELER CORPORATION
165 Broadway · New York 6, New York

FOSTER WHEELER

"Don't send a boy to do a man's work"

There's a Powell Valve* that's just *right* for every known FLOW CONTROL SERVICE

Most valve failures are the result of misapplication . . . installing valves that aren't of the right design or sturdy enough to do the job for which they are selected. In other words, it's like "sending a boy to do a man's work."

On the other hand, it's a waste of money to specify costly valves for services where less expensive ones may be used. This amounts to putting a man on a job that a boy can do.

To avoid misapplication: (1) standardize on Powell Valves; (2) consult Powell Engineers as to which valves are specifically adapted to each and everyone of your individual flow control requirements.

Powell makes such a *complete* Line* that there is a Powell Valve *exactly* suited to every existing service, from the simplest to the most specialized or exacting. Ask your nearest Distributor—or write direct.

Fig. 1314-A—Class 1500-pound Steel "Y" Valve. Has integral bonnet and welding ends.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

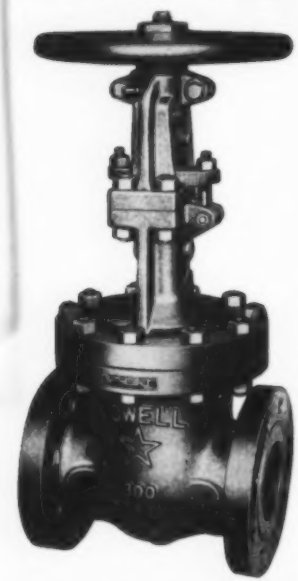


Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 1709—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

* Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

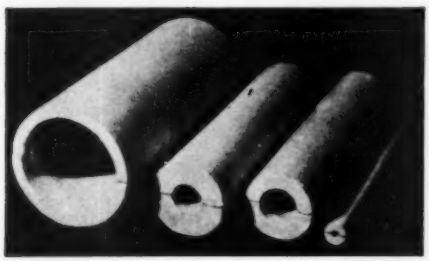
NOW!

One PIPE INSULATION COVERS TEMPERATURES FROM 200°F. to 1200°F.

KAYLO®
PIPE INSULATION

Here's a real advance in pipe insulation you should know about—the broad adaptability of Kaylo Pipe Insulation in serving a 1000° range of temperature requirements. To get a Kaylo Pipe Insulation sample and descriptive folder, fill in and send the coupon below. These are some of the reasons you'll be interested:

- Kaylo Pipe Insulation offers remarkable efficiency from 200° up through 1200°. It withstands effects of vapor and water.
- Simplified Dimensional Standards of thicknesses and diameters allow snug-fitting nesting of successive layers, when necessary—simplify installation and permit minimum inventories.
- Easy to handle and apply, this strong, lightweight insulation can be cut, scored and sawed with standard tools.
- The experiences of varied industries with millions of feet of Kaylo Pipe Insulation attest to its wide-range efficiency and long service capacity.



Kaylo Pipe Insulation is available in nominal thicknesses from 1 to 3 inches in 36-in. sections, for pipe sizes from ½ inch to 12 inches. Kaylo Insulation is also available in block and lagging form.

MAIL COUPON FOR KAYLO PIPE INSULATION SAMPLE AND DESCRIPTIVE FOLDER

This new folder tells you all about Kaylo Pipe Insulation—the available sizes and recommended thicknesses for various temperatures; physical characteristics; efficiencies, and heat losses.

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RESPONSIBILITY
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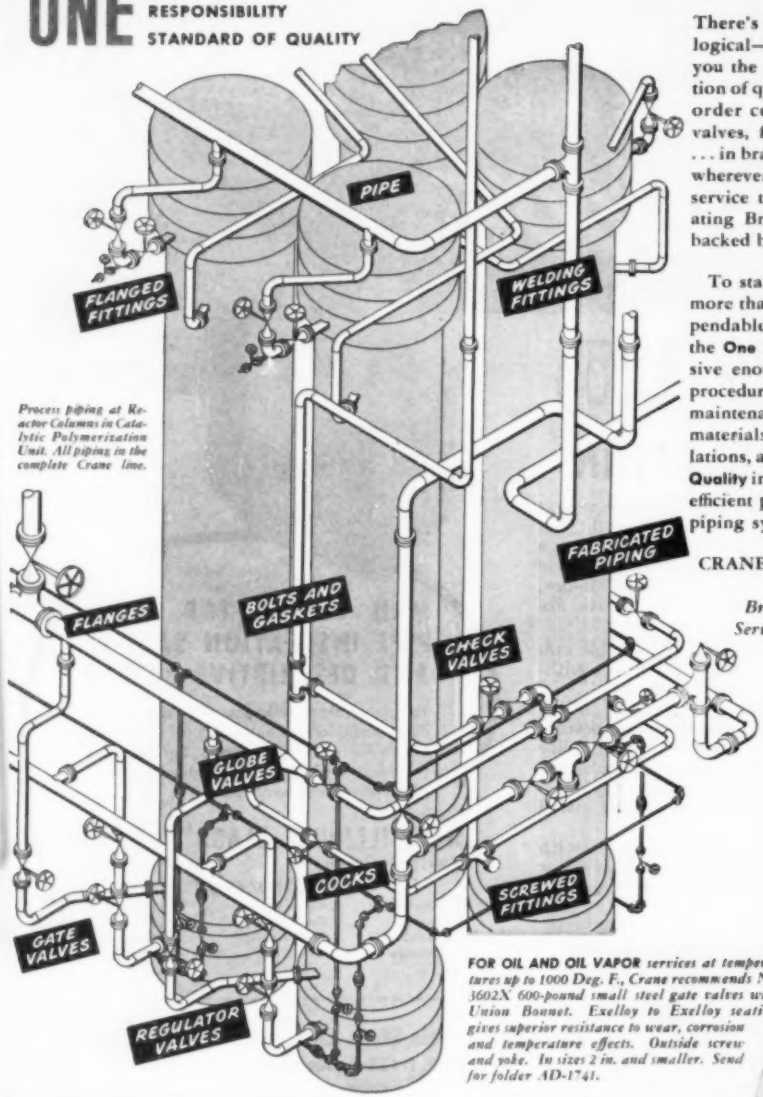
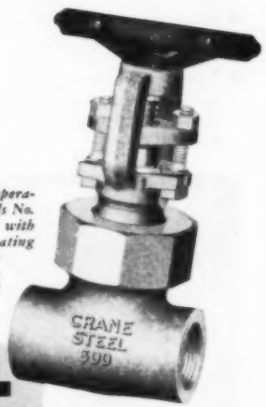


Process piping at Reactor Columns in Catalytic Polymerization Unit. All piping in the complete Crane line.

There's no more advantageous—or logical—source to rely on. Crane offers you the world's most complete selection of quality piping equipment. One order covers whatever you need—valves, fittings, pipe and accessories . . . in brass, iron, steel and alloys. And wherever you are, you're sure of better service through well-stocked cooperating Branches and Wholesalers . . . backed by large factory stocks.

To standardize on Crane gives you more than complete selection plus dependable local distribution. Crane is the **One Source of Supply** comprehensive enough to simplify your piping procedures, from design to erection to maintenance. **One Responsibility** for materials helps to assure better installations, avoids needless delays. **Highest Quality** in every item from Crane makes efficient performance throughout your piping system a foregone conclusion.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



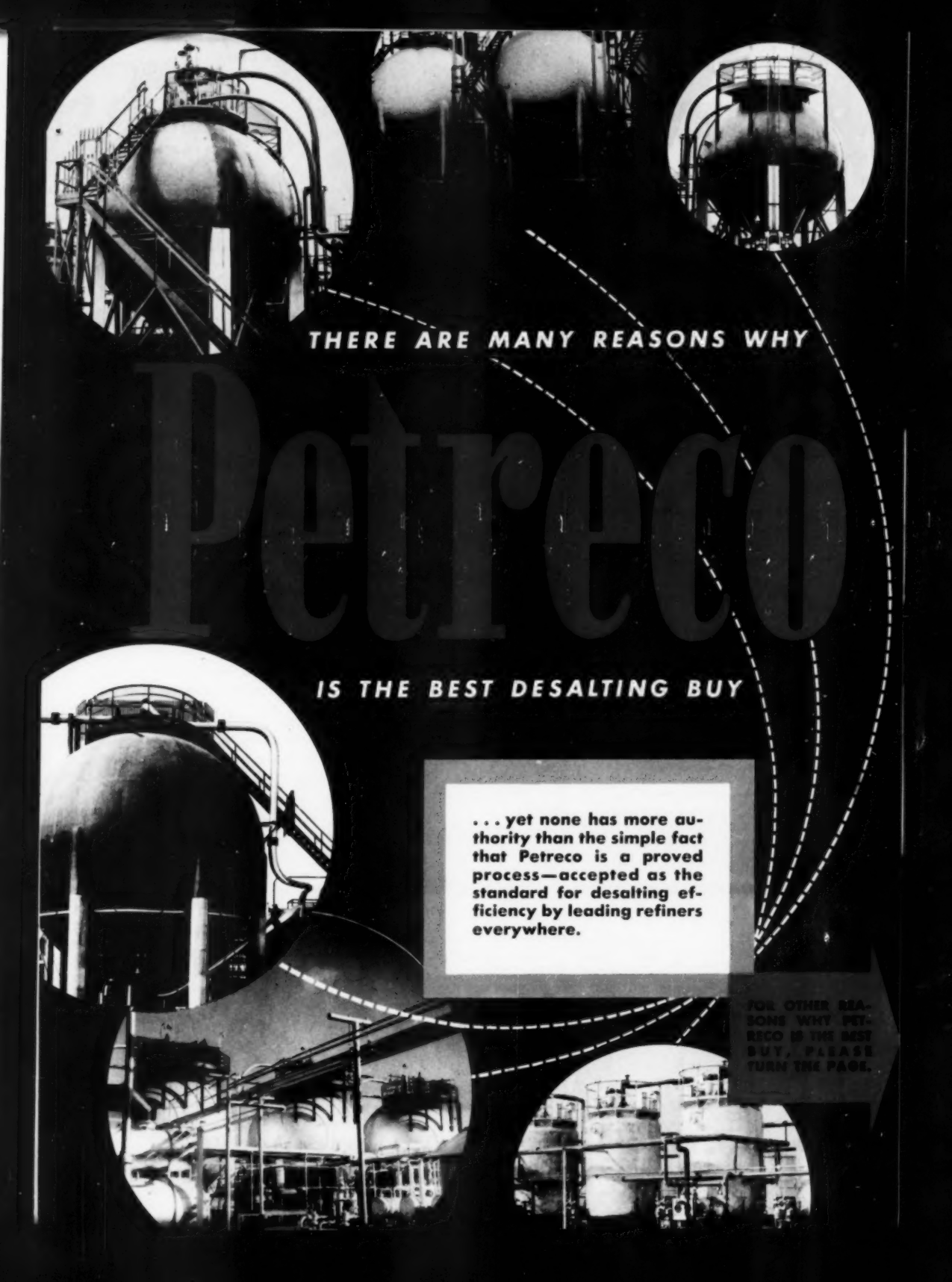
FOR OIL AND OIL VAPOR *services at temperatures up to 1000 Deg. F., Crane recommends No. 3602X 600-pound small steel gate valves with Union Bonnet. Exalloy to Exalloy seating gives superior resistance to wear, corrosion and temperature effects. Outside screw and yoke. In sizes 2 in. and smaller. Send for folder AD-1741.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

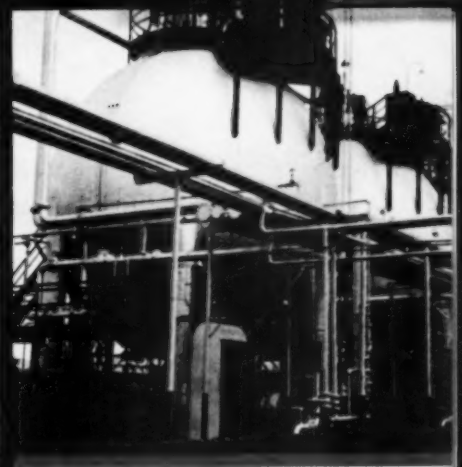
CRANE

FOR EVERY PIPING SYSTEM

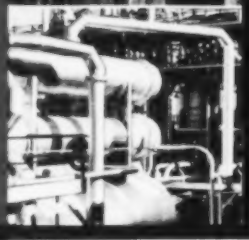

THERE ARE MANY REASONS WHY
Petreco
IS THE BEST DESALTING BUY
. . . yet none has more authority than the simple fact that Petreco is a proved process—accepted as the standard for desalting efficiency by leading refiners everywhere.
FOR OTHER REASONS WHY PETRECO IS THE BEST BUY, PLEASE TURN THE PAGE.

PETRECO DESALTING

consistently delivers a crude charge with minimum salt and solid content. A recent survey of all Petreco Desalters operating in oil refineries throughout the United States and Canada disclosed that Petreco Desalting was showing a very rapid pay-out in terms of improved refinery operations. It showed that:



THESE OPERATING ADVANTAGES	resulted directly in	THESE PROFITABLE ECONOMIES
Higher cracking temperatures.		*Deeper cracking, increased gasoline yield.*
Less plugging in furnace tubes.		*Fewer tube failures, higher charge rates.*
Reduced corrosion in overhead equipment.		*Less shut-downs due to mechanical failures.*
Less plugging in exchangers.		*Lower clean-out costs, more efficient heat exchange, longer runs.*



ONLY PETRECO OFFERS COMPLETE DESALTING SERVICE, PERSONNEL AND FACILITIES

These are not the *only* benefits to be derived from Petreco Desalting – they are the benefits consistently enjoyed by the majority of Petreco users. For complete information on Petreco Desalting get in touch with the nearest Petreco office.

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PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

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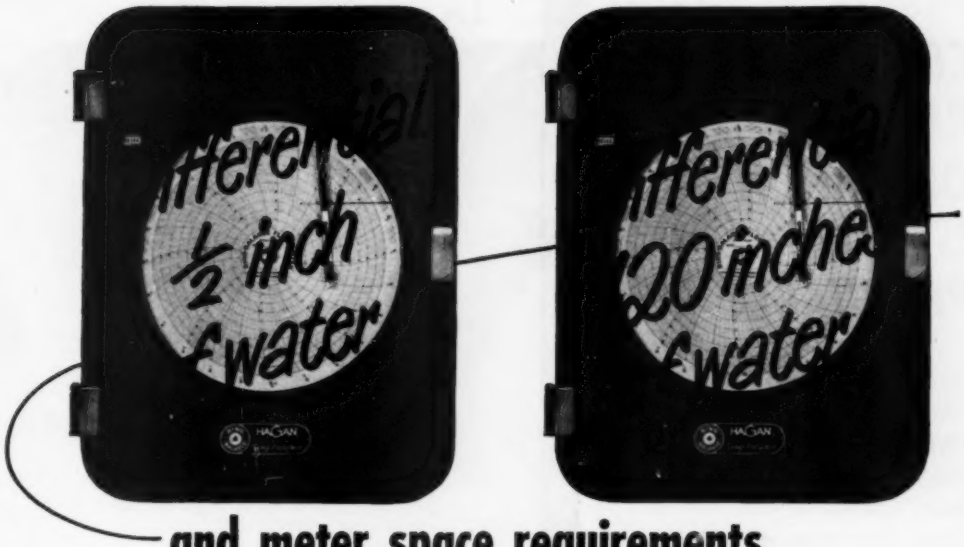

and meter space requirements are exactly the same with

Hagan Ring Balance Flow Meters

Your metering problem may call for a differential of as little as ½ inch of water, or as much as 420 inches—but meter space requirements are exactly the same with Hagan Ring Balance Flow Meters.

These meters employ the same standard size meter case, occupy the same panel area, whatever the differential. For differentials up to 420 inches of water, small-diameter rings connected in series are used. For low differentials a single ring of larger diameter is employed.

Hagan Ring Balance Dual Meters give the engineer an opportunity to save considerable panel space. Essentially the Dual meter is two meters recording on a single chart, housed in a single meter case—and this meter case, too, requires no greater panel area than the single ring meters, increasing only slightly in depth. If it is desired to totalize one or both flows, integrators may be added, and these fit within the regular meter area.

Space saving is only one of the many advantages of this extremely versatile meter. For full information on any application in which you are interested, just fill out the coupon below or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN HALL BURDMIN CALGON

HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

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Hagan Building
323 Fourth Avenue
Pittsburgh 30, Pa.

Please send me further information on Hagan Ring Balance Flow Meters. I am particularly interested in

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MORE TIME ON STREAM
OPERATIONS ACCORDING TO PLAN
FEWER UNSCHEDULED SHUT DOWNS
REDUCED REPAIR AND MAINTENANCE COSTS
these advantages all add up to
CONTINUOUS OPERATIONS
Assure them for your refinery —

SPECIFY TRET-O-LITE

CHEMICAL DESALTING

...helps refiners to maintain a continuous schedule of operations by preventing frequent shut-downs due to salt plugging and hard coking, and by helping to curtail corrosion damage. Many leading refiners rely on Tret-O-lite for efficient salt removal—for complete information, write or call

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DESALTING | DEHYDRATING

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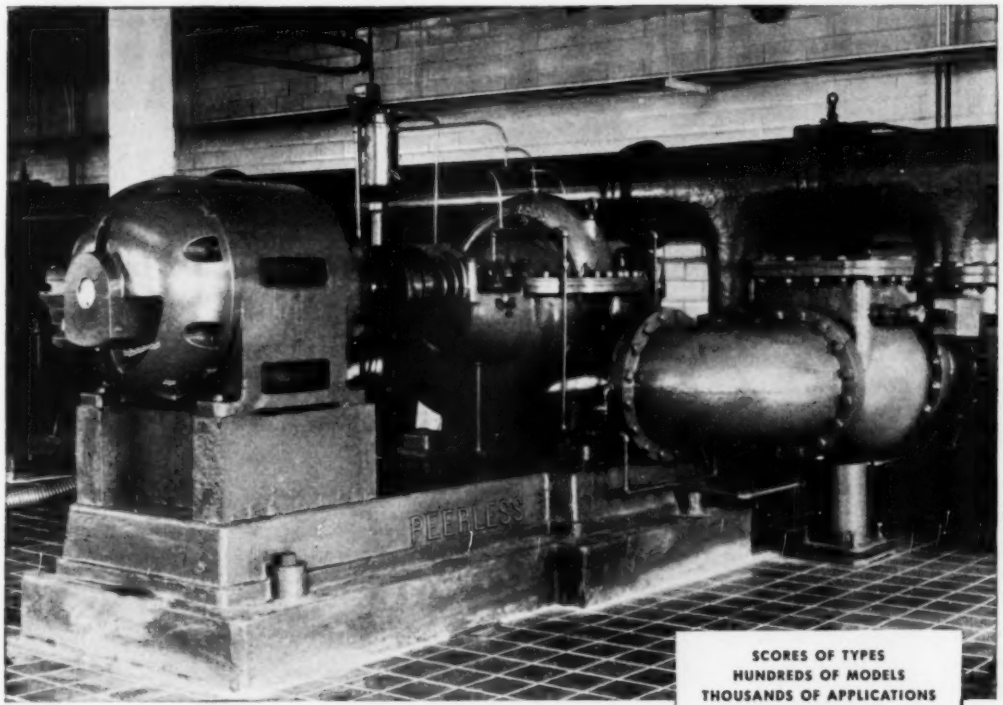
PEERLESS HORIZONTAL CENTRIFUGAL PUMPS



For continuous or intermittent duty in a host of diversified services

Select the pump you need for the process you use from the diversified line of Peerless horizontal pumps. The pump shown above, a Peerless general purpose pump handling plant process water, typifies a host of efficient Peerless centrifugal pumps which are boosting output and cutting costs for manufacturers and municipalities everywhere. With its comprehensive line of horizontal pumps Peerless can handle chemicals or alkaline liquids, pump clear water or solids in suspension. There are pumps for fluids at high temperatures or they can furnish water or foam for approved plant fire protection. Peerless will move volatile butane-propane or tricky caustics and acids. Pumps are available for all practicable heads and capacities. Duty can be continuous or intermittent. Construction materials are suited to the liquid being pumped. And, backing up their installation qualified Peerless field engineering service is available in all principal cities to see that each pump matches or exceeds customer expectations. Write today for pump engineering information on your process or service. The chart at right lists a number of the types of Peerless horizontal centrifugal pump bulletins in which you will be interested.

SCORES OF TYPES
HUNDREDS OF MODELS
THOUSANDS OF APPLICATIONS

Here are a few of the services which Peerless horizontal pumps can perform. Plan with Peerless. Request copies of the Bulletins you need by Bulletin number.

Pump Service	Bulletin No.
Water Supply	B-1300
Fire Protection	B-1500
Chemicals and Oils	B-810
Vaporous Liquids	B-2201
Butane-Propane	B-2200
Boiler Feed	B-806
Sewage and Solids	B-134
Hi-Pressure	B-310
Acids and Caustics	D-2400
Process Services	B-803
All-purpose Pumps	B-2301

Peerless
VERTICAL AND HORIZONTAL
Pumps

fmc PEERLESS PUMPS

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FOOD MACHINERY AND CHEMICAL CORPORATION
Los Angeles, California — Indianapolis, Indiana
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PROCESS ENGINEERS and CONSTRUCTORS for the CHEMICAL, PETROLEUM and PETRO-CHEMICAL INDUSTRIES

ORGANIZATION

Badger often works as a supplemental organization to the client's permanent engineering staff

Many large companies having permanent engineering and technical staffs of their own for long range planning and current operations employ Badger for immediate major expansion projects. Because we work for many clients as their supplementary engineering department, we maintain an organization fully equipped to absorb your overload. This relieves management of the responsibilities often arising from sudden increases in engineering, procurement and construction loads and further permits the client's key technical personnel to work in close cooperation with us as the project may require.

Badger's ability to work as a supplemental organization, backed by broad experience in the petroleum, chemical and petro-chemical fields, insures overall execution in accordance with the client's concepts without the necessity for burdensome attention to details.

E. B. BADGER & SONS CO. Est. 1891

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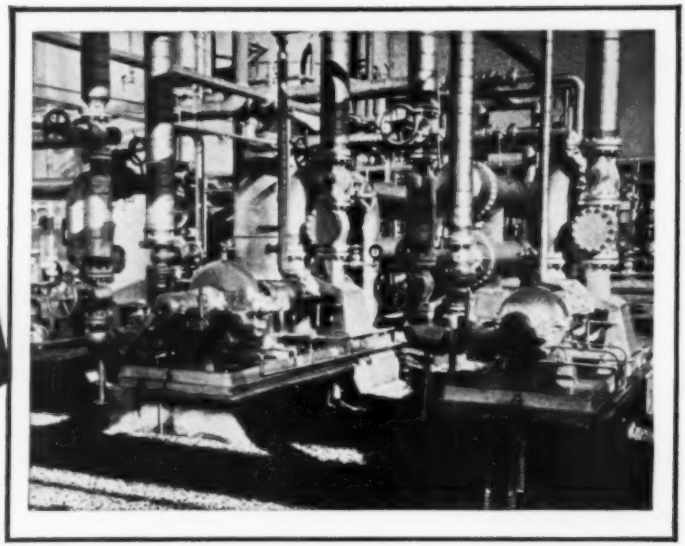

High Pressure Problems?

Made from Alloy Steel—from the furnaces of Republic, world's leading alloy steel producer.

No matter how high the operating pressures, you'll find a quick, economical solution to stud failure problems when you use Republic Upson Alloy Steel Studs. These tough, heavy-duty studs are made to hold tight under the most severe service conditions. They offer excellent resistance to corrosion and high temperatures, and afford positive, inexpensive insurance against excessive maintenance costs.

Better yet, start out right by specifying Republic Upson Alloy Studs in new equipment before high pressure problems begin.

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BOLT & NUT DIVISION • CLEVELAND 13, OHIO
Export Department: Chrysler Building, New York 17, New York

REPUBLIC *Upson Quality* **ALLOY STEEL STUDS**

Other Republic Products Include Machine, Tank and Carriage Bolts—Lag Screws, Cap Screws and Rivets

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

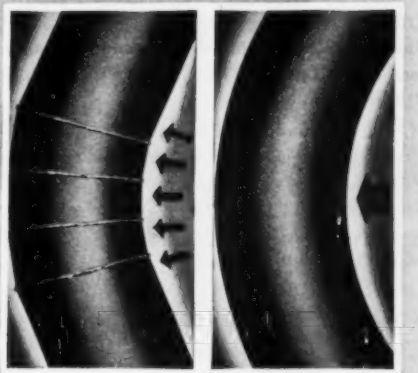
Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

If you're planning process piping larger than 30" in diameter....

It will pay you to investigate Kellogg ONE-PIECE bends!

New one-piece giant bends radically reduce erosion and corrosion!



In process pipe larger than 30" in diameter, bends have customarily been made by welding segments together (left). The irregular contour of such bends increases erosive effects of flowing material through successive, abrupt changes in direction of flow. Similarly, corrosion problems are intensified where these sharp changes in direction of flow set up eddies and pockets of corrosive material. Smooth, precisely contoured ONE-PIECE bends reduce erosion and corrosion to a minimum.

Makes first 50" one-piece bends!

LAST year Kellogg made the first 50-inch one-piece pipe bends—for one of the toughest services imaginable, the main catalyst carrier lines in large Fluid catalytic crackers. Such lines handle more than 600 freight cars of erosive catalyst at 1000°F. in each 24 hours. Mass velocities exceed 4500 lbs. per sq. ft. per minute.

Actual plant service has now provided documentary evidence of the advantages of these one-piece bends. They improve uniformity of flow of powder; reduce pressure drop; radically reduce erosion and thereby eliminate the need for the installation and regular replacement of expensive wear plates required in segmented bends.

Similar advantages are apparent in the handling of corrosive materials. The smooth, regular contours of these *one-piece* bends eliminate the eddying of corrosive material ordinarily present between segments, where changes in direction of flow occur.

While initial costs of these Kellogg *one-piece* bends are roughly comparable to welded-segment bends, ultimate costs, when maintenance and service life are included, show major savings. Kellogg makes *one-piece* bends up to 96" outside diameter.

To master temperature, pressure and chemicals use

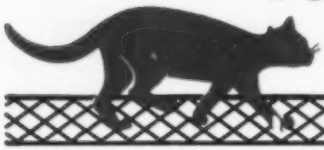
M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

FOR CATWALKS, PLATFORMS



. . . and for hundreds of other Petroleum Industry uses!

WHEELING EXPANDED METAL

FOR CATWALKS as safe as sidewalks, it pays to use Wheeling Expanded Metal. This modern construction metal is STRONGER THAN SHEET STEEL OF THE SAME WEIGHT.

Check the hundreds of uses around oil industry installations where Wheeling Expanded Metal can contribute to safety . . . add to convenience. Use it for machine guards, tool room enclosures, lockers, bins, shelving, fencing . . . any place where cleanliness is needed . . . where light and air are important . . . where safety is a factor.

Wheeling Expanded Metal comes in many mesh sizes and weights. Write us for full information.

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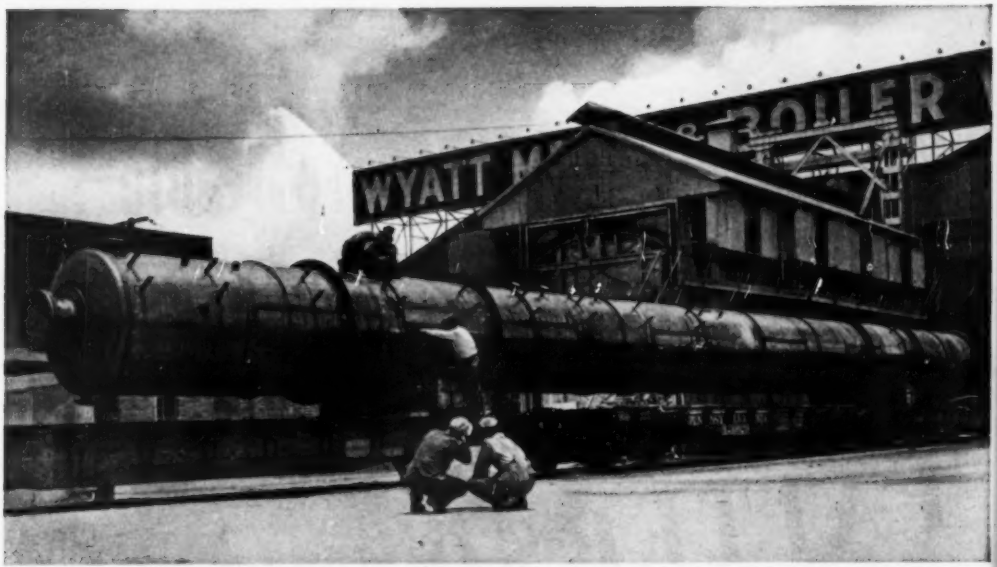
HERCULOY



Fractionating column, 108' 6" high, 78" I.D., fabricated out of Revere's Herculoy by the Wyatt Metal & Boiler Works, Houston, Texas.

FRACTIONATING columns need strength, because of their height, and also because they often must resist considerable pressure. They also must be immune to attack by the fluids and vapors involved in the fractionating process.

Such specifications of the chemical industry spell Herculoy. This copper alloy is Revere's silicon bronze, a remarkable metal with the corrosion resistance of copper, and the strength of mild steel. Herculoy Alloy No. 420, for example, has a tensile strength of 94,000 psi, for sheet in hard temper, and 60,000 psi, soft. It can be readily welded by any of the commercial methods.

The illustration shows a giant column made of Herculoy by the Wyatt Metal & Boiler Works, Houston, Texas. Fabrication: welding by Heli-arc method, using Herculoy 420 welding rod. The column stands 108' 6" high, and the inside diameter is 78".

It is a pleasure to report that more and more Herculoy is being used by fabricators for the refining and chemical industries, not only for fractionating columns, but also for tanks, pressure vessels, and other applications in which strength and corrosion resistance are vital. The Revere Technical Advisory Service will gladly collaborate with you on Herculoy, which is made by Revere not only in sheet, strip and plate, but also in rod, wire, tube and forgings.

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COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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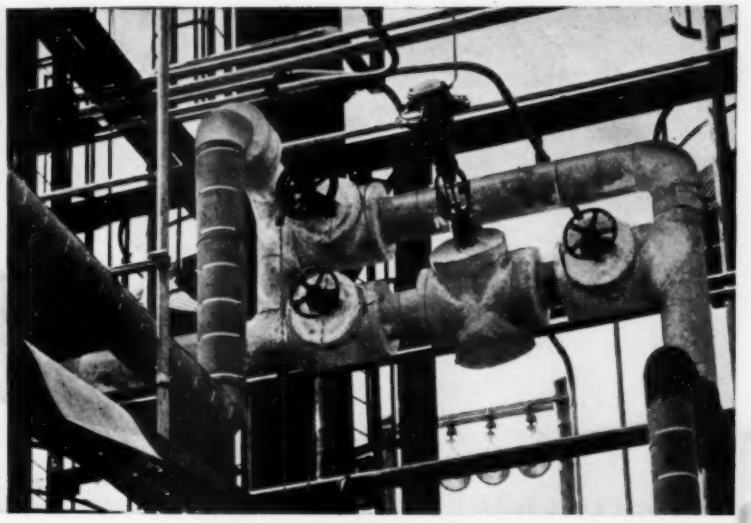

UNIBESTOS

PIPE COVERING IN PROGRESS AT NEW PROCESSING PLANT IN WEST VIRGINIA

Giant oil refineries and chemical processing plants everywhere, specify UNIBESTOS for ease of installation and the substantial savings afforded by Unibestos Single Layer Construction.

What's more, Petroleum Engineers rightfully demand top efficiency in a wide range of operating conditions. *Unibestos successfully meets such requirements.*

Here's a single layer pipe covering that is easy to cut, strip and apply. Light in weight, yet highly resistant to shock or vibration, Unibestos will not break in transit and, with ordinary handling, will not crack or break on the job.

In use, Unibestos, high in physical and chemical stability, great in structural strength, is ideal for high temperature work . . . stands up under repeated water saturation . . . will not split under steam pressure.

Pipe inspection is speedy and less costly, as Unibestos can be quickly removed then easily reapplied . . . with no loss of efficiency.

UNARCO

Now serving the great Southwest, Union Asbestos & Rubber Co.'s new plant at McGREGOR, TEXAS

UNIBESTOS No. 750 is suitable for temperatures up to 750° F. No. 1200 or Combination are recommended for temperatures up to 1200° F. These temperature ranges permit the use of one material at maximum efficiency for a wide variety of purposes. Unibestos is available in half-sections up to 30" pipe diameter, in quadrants up to 60" diameter, and in cylindrical form where specified. UNIBESTOS No. 750, No. 1200, and Combination are all furnished in single layer construction.

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UNION ASBESTOS & RUBBER COMPANY
1823 South 54th Avenue, Cicero 50, Illinois

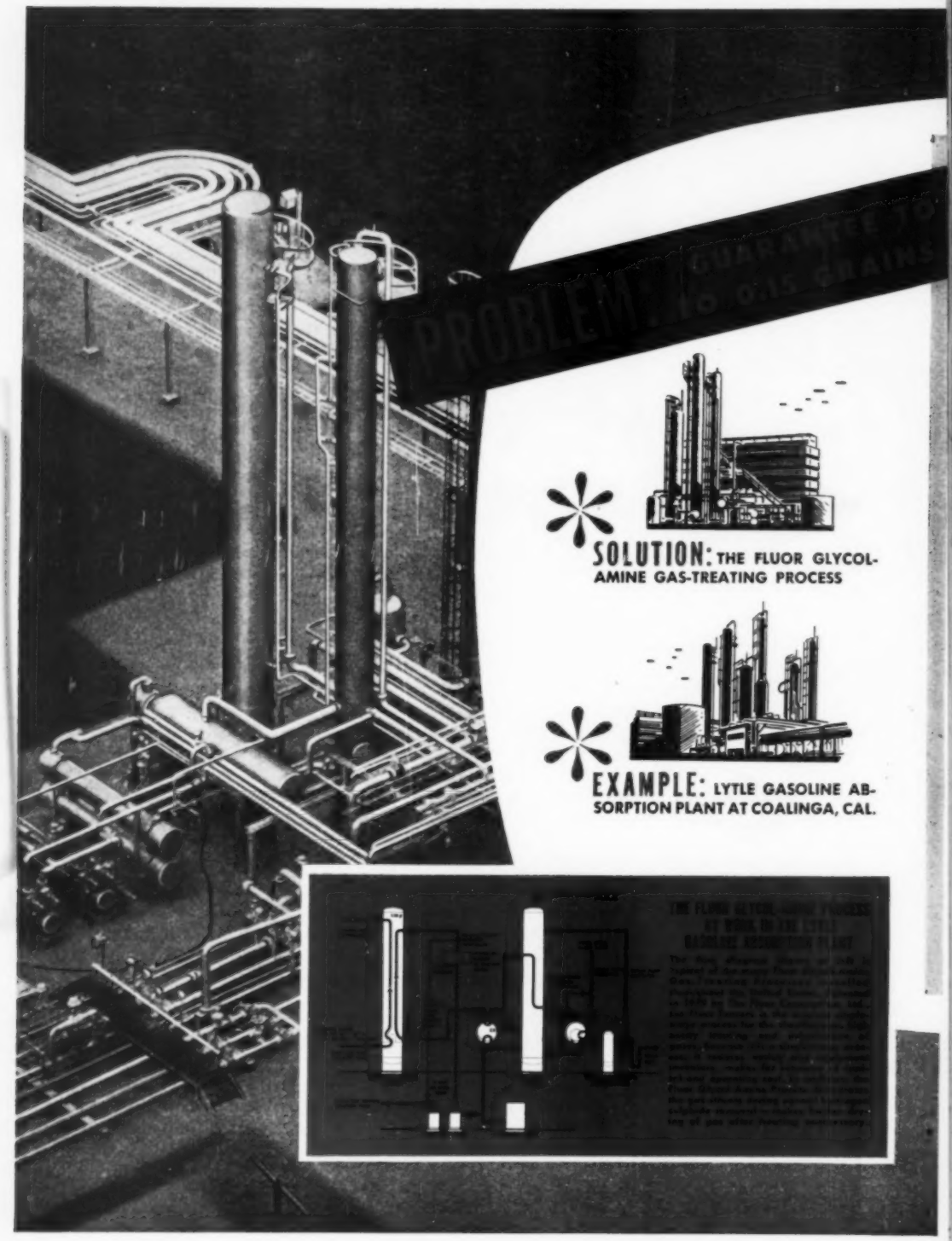
Gentlemen:

Please send illustrated folder showing sizes, prices, conductivity curves and technical information to

Company _____

Address _____

Name _____ *Title* _____


PROBLEM:
SOLUTION: THE FLUOR GLYCOL-AMINE GAS-TREATING PROCESS
EXAMPLE: LYTLE GASOLINE ABSORPTION PLANT AT COALINGA, CAL.

The Lytle Gasoline Absorption Plant at Coalinga, California, is a story of the Fluor Glycol-Amine Gas-Treating Process at work.

Expansion of natural gas supply through deeper drilling introduced into the Lytle Plant a natural gas so high in hydrogen sulphide content that it was no longer acceptable as commercial sales gas. After processing for gasoline recovery, the discharge gas was analyzed and found to contain 1.25 grains of hydrogen sulphide per 100 SCF and up to three-fourths of 1 mol per cent of carbon dioxide. Even though this gas was sufficiently pure for sale in many areas, in this particular instance requirements for commercial gas were set to *not more than 0.15 grains of hydrogen sulphide per 100 SCF*... a purity requirement so stringent that it would only be attempted by Fluor Gas Processing Engineers using the Fluor Glycol-Amine Gas-Treating Process.

Following study of the requirement by Fluor, a Research Department pilot plant was set to run at gas composition and operating conditions simulating those at the Lytle Plant. Here it was *proved* the Fluor Glycol-Amine Gas-Treating Process could meet—*and exceed by a comfortable operating margin*—the 0.15 grain per 100 SCF requirement efficiently, economically, and on a guaranteed basis.

The plant for the Lytle job was then designed on the findings of the Fluor Research Department. Engineering was set in motion, and a field construction schedule formulated.

The Lytle unit is a "sweet"-running unit paralleling laboratory and pilot plant findings—meeting its guaranteed performance with an adequate margin. This new installation raises the total installed capacity of Fluor Glycol-Amine Gas-Treating Plants to 585,000,000 SCF/D.

Fluor invites owners and operators of gas-producing properties to submit their gas-treating problems for study and recommendation by Fluor's Gas Processing and Research Engineers. Let them study *your* particular problem—the range of purity obtained through use of the Fluor Glycol-Amine Gas-Treating Process is virtually unlimited. It may be the low-cost answer to your gas-treating problem.

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FLUOR

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Designers and Constructors of Refinery, Chemical and Natural Gas Processing Units.

Manufacturers of Cooling Towers, Fin • Fan Units, Mufflers, Gas Cleaners, and Pulsation Dampeners.

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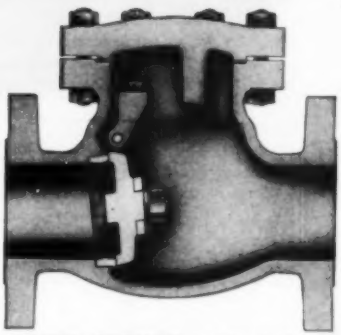
THE NEW O. I. C. LINE of forged-steel valves is built for 600 lb at 900 F in screw-end types, and for 600 lb at 750 F in flanged-end types. Sizes: with union bonnets, 1/4 in. to 3/4 in.; with bolted bonnets, up to 2 in.

These gate, globe, angle, and swing check valves are sturdily built, compact, easily operated and maintained. Every part is carefully designed and accurately machined. Ample wall thicknesses are maintained throughout. Each valve is individually factory-tested and carries a standard identification plate.

Yes! O. I. C. VALVES ARE AVAILABLE AT EVERY BETHLEHEM SUPPLY STORE

No need to waste time hunting. Bethlehem Supply Company's stores — almost forty of them—carry O. I. C. valves in the various sizes and types you need. One telephone call will enable us to take care of your complete requirements.



SWING CHECKS—Body designed for unobstructed flow; no tapped openings through the body wall; all internal parts removable through cap opening.

Special Features—straight-through ports; end-type seated seat rings; full-threaded bolt studs.

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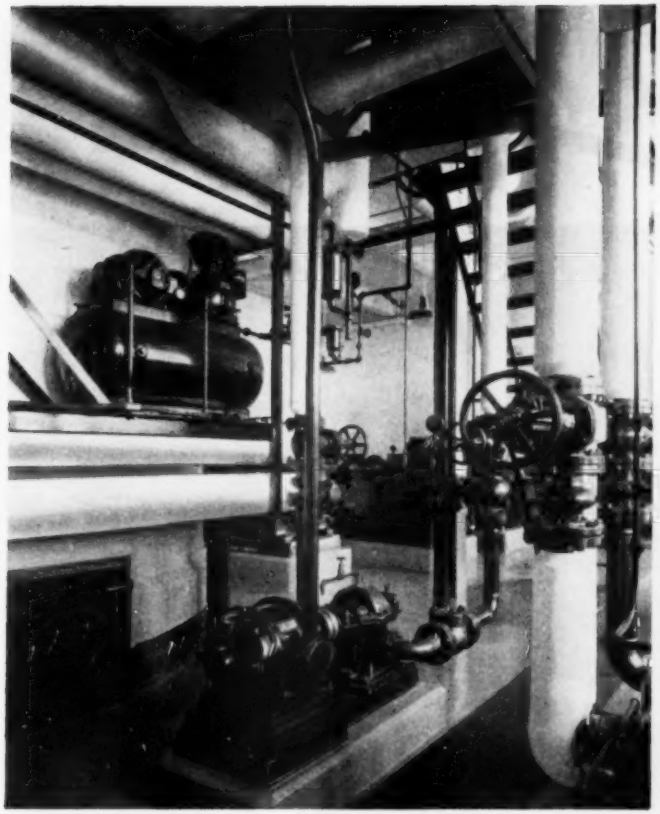

Pratt & Whitney's 14-mile K&M insulation starts here. It's fit for the job and looks fit!

Where K&M "*Featherweight*"® 85% Magnesia

Keeps up steam...keeps down cost...for 14 miles

Pratt & Whitney Division of Niles-Bement-Pond Company, West Hartford, Conn., has long been noted for fine machine tool, cutting tool and precision gauge manufacture. The scientific attitude is a Pratt & Whitney habit. They applied it to saving b. t. u.'s along 14 miles of steam lines throughout their large power plant and shops. That led them to use K&M "Featherweight" 85% Magnesia pipe insulation for maximum efficiency and permanence.

The inherent insulation effectiveness of K&M "Featherweight" 85% Magnesia comes from basic Carbonate of Magnesia. This is combined with clean Asbestos Fibre in correct proportion for needed weight-saving strength. Therefore it is easy to do a fast, shipshape insulation job whose continued efficiency does not depend on costly maintenance.

Designed for temperatures to 600° F., K&M "Featherweight" 85% Magnesia comes in all standard sizes. Like the other K&M insulation materials, it can save you waste—difficulty—money. Get help on any points by consulting your nearest K&M Distributor—an insulation expert.

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
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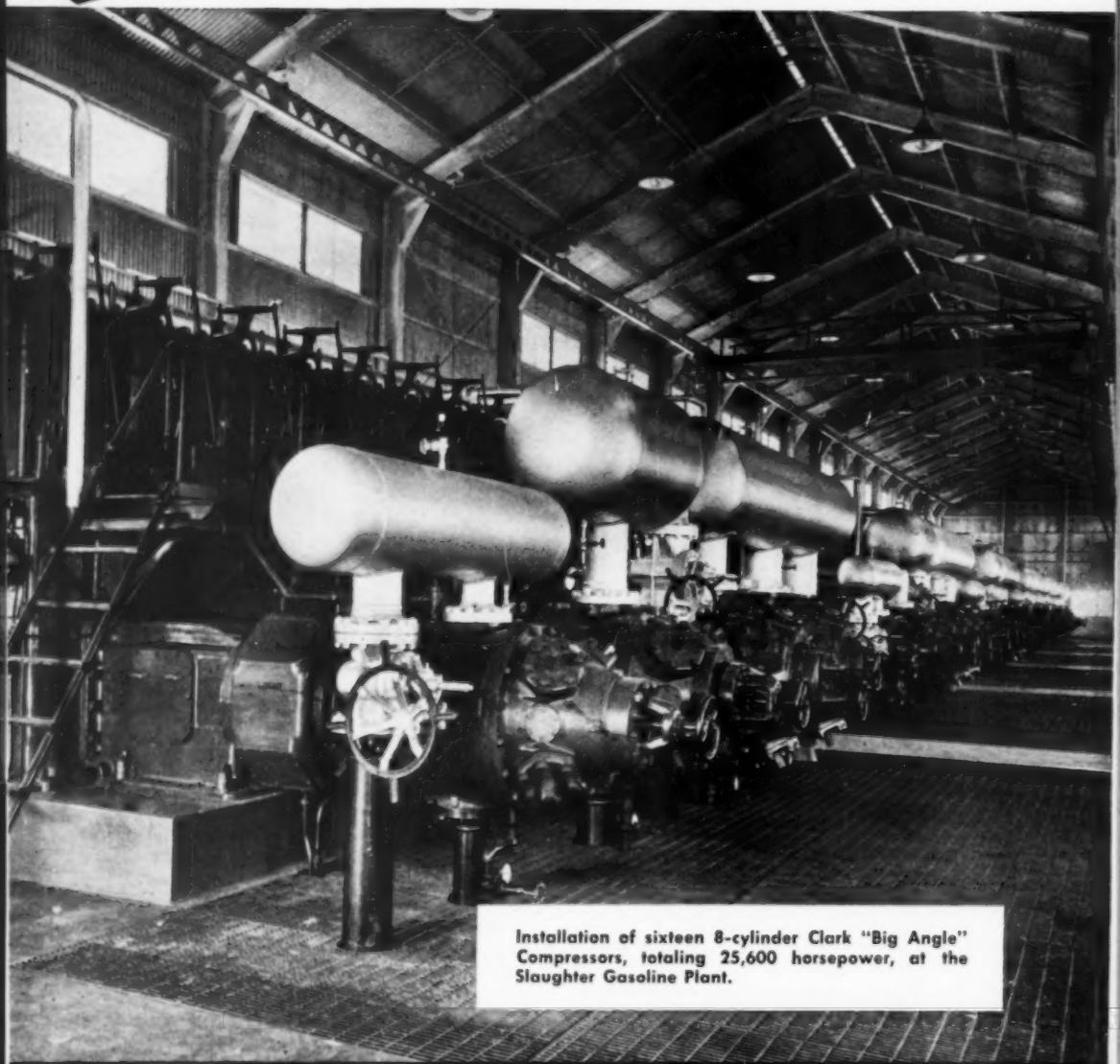
K&M Heat in asbestos ®

Again! "BIG ANGLES"



Installation of sixteen 8-cylinder Clark "Big Angle" Compressors, totaling 25,600 horsepower, at the Slaughter Gasoline Plant.

CLARK "BIG ANGLE"

ONE OF THE DRESSER INDUSTRIES

AID CONSERVATION

25,600 CLARK "BIG ANGLE" HORSEPOWER SERVES MAJOR CONSERVATION PROJECT AT SLAUGHTER POOL, TEXAS

At the new Slaughter Pool Natural Gasoline and Gas Conservation plant*, Clark "Big Angle" Compressors are a vital part of a major conservation project. These units make up the largest compressor installation in the natural gasoline industry.

The plant is designed for the production of natural gasoline, butane and propane—from gas formerly burned off as flare gas. In addition, the dry residue gas is sold to a gas pipe line company for use as fuel.

Sixteen 8-cylinder "Big Angles", rated at 1600 BHP each, are used to compress about 90,000,000 cubic feet of "casinghead" gas per day from 13.2 psia to 713 psia in three stages—at a plant elevation of 3,000 feet.

The Clark "Big Angle" Compressors are aiding conservation by meeting the Oil Industry's needs for high-powered, heavy-duty, Gas-Engine-Driven Units. The BA has a wide operating range and is the most accessible for servicing of any compressor . . . saves money on both maintenance and installation costs.

WRITE FOR BOOKLET

For complete description, dimensional drawings and other data on "Big Angle" Compressors, send for Bulletin B-A.

CLARK BROS. CO., INC. • OLEAN, NEW YORK

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Lima, Peru • Bogota, Colombia • New Delhi, India

*THE SLAUGHTER PLANT IS OWNED BY: Stanolind Oil and Gas Company; The Texas Company; Honolulu Oil Corporation; Magnolia Petroleum Company; The Devonian Company; The Atlantic Refining Company; Saltmount Oil Company; Mid-Continent Petroleum Corporation.

COMPRESSORS ★ ★ ★

NOW WOLVERINE TRUFIN in BI-METAL

Combining the durability of copper (or copper alloys) with the light weight of aluminum, this new finned tube offers you extremely high efficiency. And in addition, you have the advantage of economy. You can buy this Wolverine Trufin Bi-metal at a surprisingly low price. And like our renowned copper Trufin, whose fins are formed from the tube itself and are a part of it, this new bi-metal Trufin will resist vibration. Naturally, the copper liner can be left to extend beyond the finned tube if desired to facilitate end connections.

It is available in sizes from ⅛" to 1" inside diameter, with choice of 5, 7, 9, and 11 fins to the inch.

Send for new catalog folder No. 651 for complete information.

WOLVERINE TUBE DIVISION
CALUMET AND HECLA CONSOLIDATED COPPER COMPANY
INCORPORATED
MANUFACTURERS OF SEAMLESS NON-FERROUS TUBING
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That's all it takes! Four basic circuits and 8 basic component parts give you more than 100,000 different electronic instrument combinations for processing use.

Flow, level, speed, pressure, temperature, gas analysis, pH, conductivity, etc.—all can be controlled with these interchangeable Bailey units.

With Bailey controls, replacement part stocks are held to a minimum because parts are interchangeable. Maintenance costs are less, too, because maintenance men quickly become familiar with the standardized Bailey units.

Bailey bulletin No. 17 shows how you can use this improved control system. Write for your copy and keep it handy for reference the next time you need process controls:

P-19-O

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BAILEY METER CO. LIMITED, MONTREAL
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TEMPERATURE • FLOW • PRESSURE
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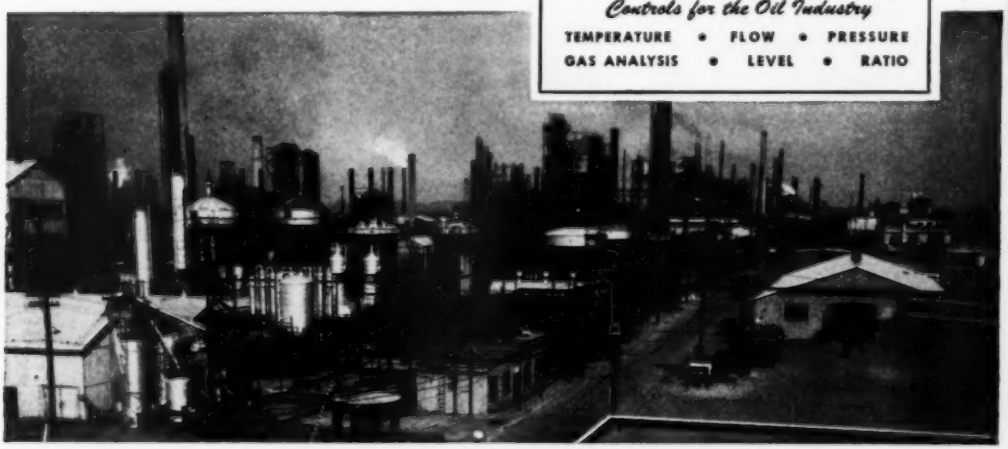
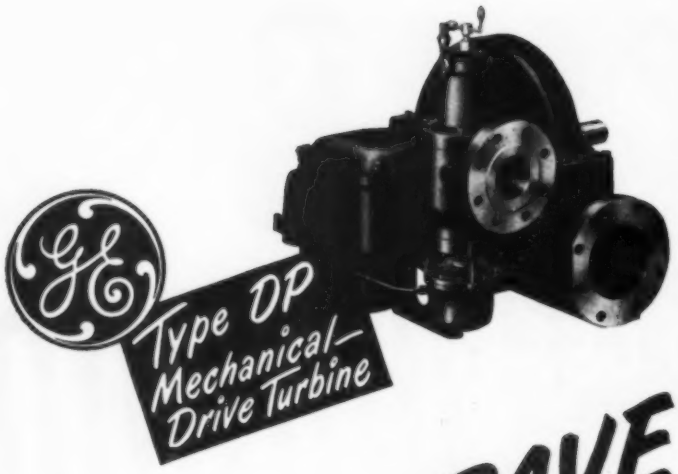


4 + 8 Works Here at Wood River Refinery of Shell Oil Company



SAVE WITH

THESE PARTS INTERCHANGEABLE
ON ALL TYPE DP TURBINES!...

STANDARDIZATION!

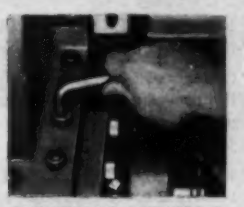
IF you operate a number of mechanical-drive turbines, interchangeability of parts can be a mighty potent factor in saving time and trouble when replacements must be made. With the General Electric Type DP you can interchange all the important parts shown—and many more—regardless of turbine size. Also, one low-cost standard spare parts kit serves any DP turbine.

Standardization saves your time when installing or relocating DP turbines too. Common shaft height, regardless of wheel size, permits you to use a standard mounting height. Since all shafts are identical, couplings can be standardized as well.

The new Type DP is not a "standard turbine" for a narrow range of ratings only, but a standardized line, in ratings from 10 to as much as 1200 hp, speeds from 1000 to 5000 rpm. Thus, if your turbine drives fall within this wide range, you can save money—time—and trouble—by standardizing on the Type DP. For full information get in touch with your G-E representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

TURBINE OIL PUMP

SOLID-BACKED BEARINGS



SOCKET-HEAD CAP SCREWS

LOW-COST STANDARD SPARE PARTS KIT

GENERAL ELECTRIC

IT'S EASY TO SERVICE A DE LAVAL TURBINE

These features cut your maintenance costs

Every part of a De Laval Class CA Turbine is designed to facilitate inspection, maintenance and servicing.

Casing and bearings split at center line for easy removal. Rotor, carbon rings and bearings can be inspected without disturbing piping connections. Precision-machined casing joints require no gaskets.

Outside adjustment for speed controls. All you have to do is remove 2 cover plugs for access to the adjusting screws.

"Rocking chair" governor pivots seldom require replacement. The "rocking chair" type of governor pivot used by De Laval has no heavily loaded knife-edges subject to concentrated wear.

Super-smooth chrome plated shaft journals make carbon rings last longer.

Maximum interchangeability of parts between frame sizes.

De Laval Class CA Turbines are made in capacities from less than 50 to more than 1500 horsepower.

Send for Catalog 4202-21-T

Before you buy a turbine, be sure and get complete information on these additional De Laval features:

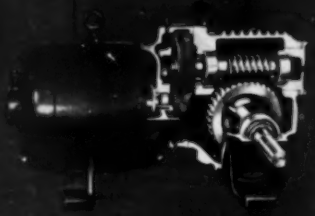
1. True center line support and flexible mounting for perfect alignment.
2. A choice of eight governors.
3. Balanced double-seated bonnet-type governor valves for close control of steam flow.
4. *Positive* over-speed protection entirely separate from normal speed governor for unfailing emergency shut-off.

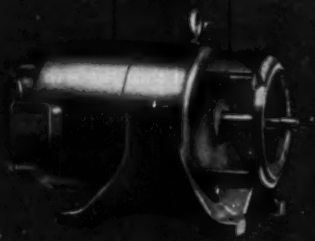
DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

DE LAVAL

T-21





Smart Engineers are taking advantage of Master's unusual ability to give them the RIGHT horsepower, the RIGHT shaft speed, the RIGHT construction features, the RIGHT mounting . . . all combined into one compact power package.

Don't put up with make-shift assemblies when you too may be enjoying these advantages. Master Motors, available in millions and millions of types and ratings (up to 150 HP) give you a selection you can get nowhere else.

Open, enclosed, splash proof, fan-cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 432 to 1 ratio . . . with electric brakes . . . with mechanical variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best motor drive for YOU.

Select the RIGHT power drive from Master's broad line and you can increase the saleability of your motor driven products . . . improve the economy and productivity of your plant equipment.

the smart boys are taking advantage of us

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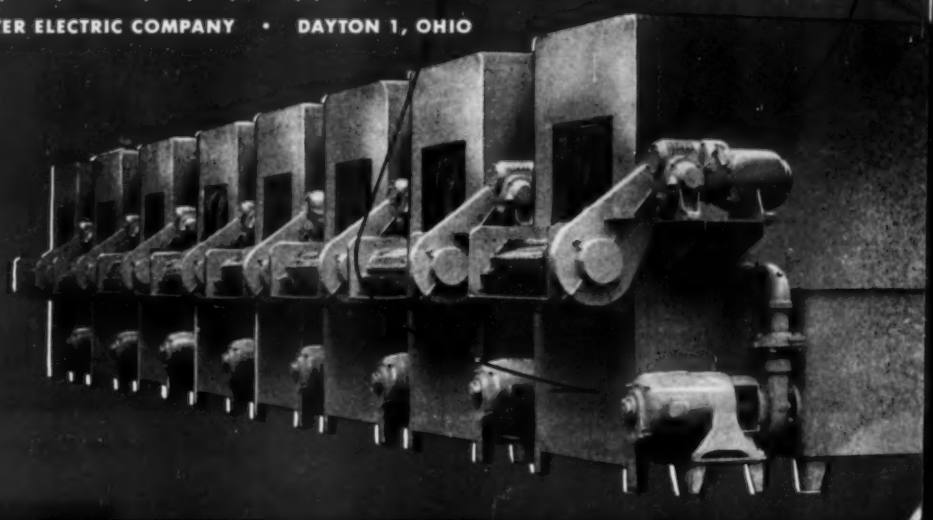
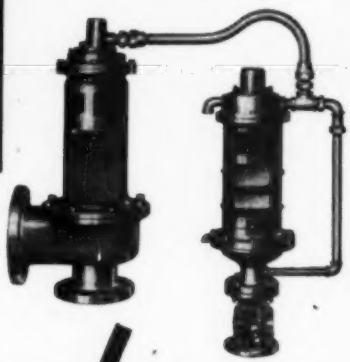


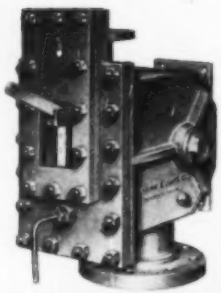
HEADQUARTERS FOR LPG STORAGE TANK FITTINGS

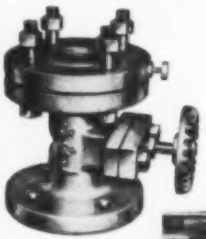
For years Shand & Jurs has furnished the major refineries of the world with safety, conservation and measuring devices for crude and refined petroleum storage tanks. The research and the designs of S. & J. engineers always parallel developments in the petroleum industry, so it is only natural that the expansion in the manufacture and distribution of Liquefied Petroleum Gases should be accompanied by a complete line of S. & J. tank fittings specifically designed for the characteristics of these gases. Shand & Jurs fittings cover the entire range from large refinery spheres to bulk stations and delivery truck tanks. If you are refining or marketing L.P. gases, we have the fittings you will want. Your inquiries are invited.

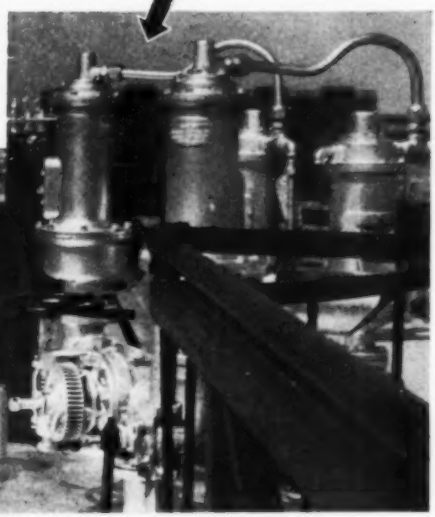
S. & J. Pilot Operated Safety Valves afford a positive means of protecting L.P.G. storage tanks from excessive internal pressures. These safety relief valves incorporate many features not found in other equipment and they are covered by U. S. Patents.



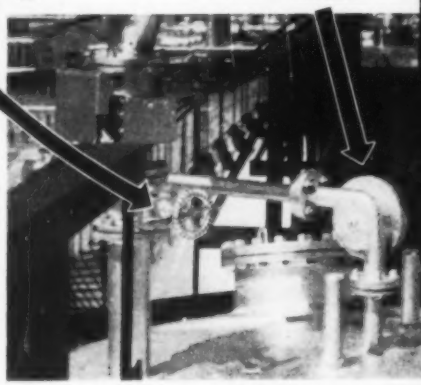
This is the S. & J. Automatic Tank Gauge Model ST-400 designed for high pressure spheres and cylindrical tanks. This gauge is of the ground reading type. We also manufacture other gauges which are read at the tank top.







This is the S. & J. model ST-5265 High Pressure Tape Block Valve, designed for locations where it is desirable to close a valve on a flat tape. These valves permit isolation of gauge heads from tank pressure and vapors, important factors in maintenance, inspection and repairing.



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Exclusive features embodied in WILFLEY Acid Pumps help you make substantial savings in the cost of handling acids, corrosives, hot liquids or mild abrasives. WILFLEY pumps are trouble-free. They operate without attention. Production records of WILFLEY installations in today's most modern chemical plants prove the cost-saving dependability of these highly efficient pumps. 10- to 2,000-G.P.M. capacities; 15- to 150-ft. heads and higher. Individual engineering on every application. Write or wire for specific information.

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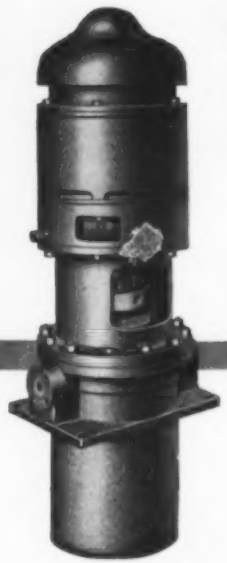
For High-Pressure Applications in Refineries and Industrial Processes



Here are 3 Reasons

why you should specify I-R Vertical Process Pumps

- ***They're easy to install***
- ***Easy to maintain***
- ***Provide better operation***

Ingersoll-Rand Class VP Pumps are vertical, multi-stage, diffusor-type units with single-suction impellers. They are made with 3, 4, 5 or 6 stages, depending on the operating conditions for which the pump will be used. Capacities range from 10 to 400 gpm . . . pressure to 750 psi.

They're easy to maintain because —

- The inner assembly can be pulled directly out of the casing without disturbing the discharge and suction piping
- There is only one stuffing box—and it is under suction pressure
- Bearings are lubricated by the liquid being pumped—No external lubrication piping
- Fewer spare parts—all the impellers and diffusors are interchangeable

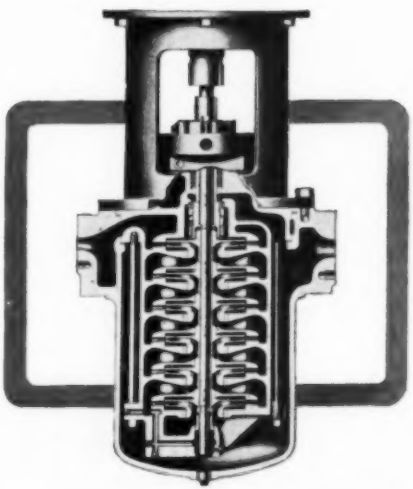
They provide better operation because —

- Diffusor-type construction eliminates radial thrust
- The first-stage impeller is located on the bottom—Extra NPSH is therefore obtained
- High pressure breakdown above the last stage impeller balances pump thrust

An Ingersoll-Rand engineer will be glad to tell you more about Class VP Pumps. Ask for your copy of Form 7145-A.

They're easy to install because —

- No bedplate or grouting is required
- A minimum of floor space is needed—only 4 sq. ft. for the largest unit
- Simplified, straight through piping—no loops —no elbows

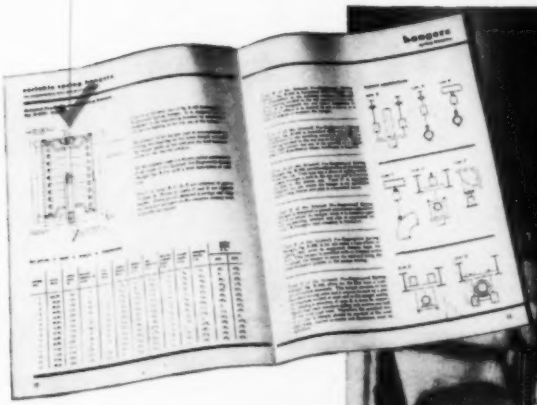


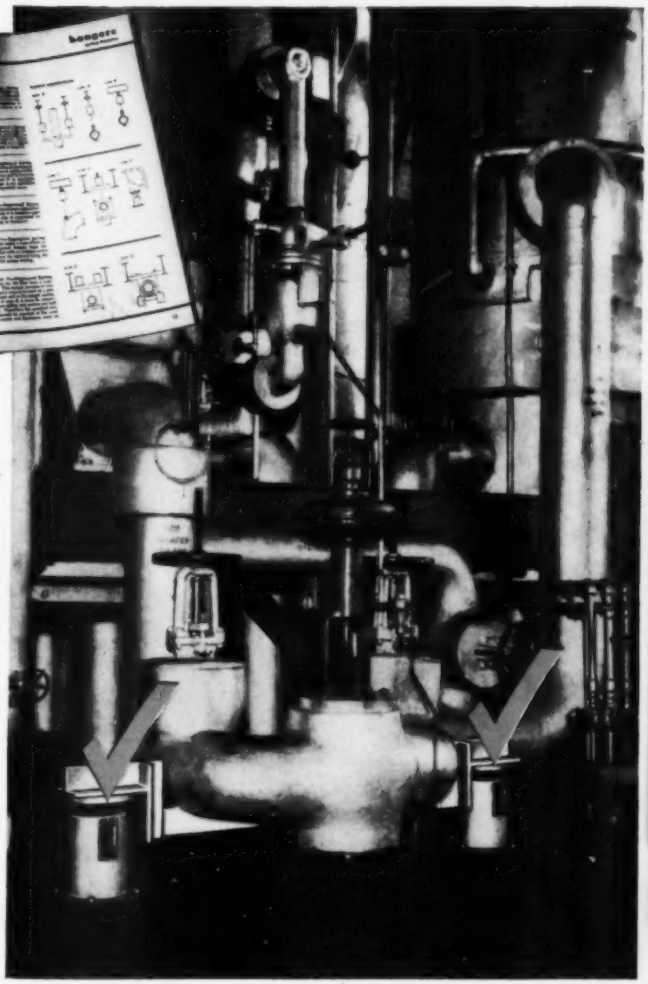
Ingersoll-Rand

Cameron Pump Division
11 Broadway, New York 4, N. Y.

434-10

The problem was "special" but the solution came "out of stock"



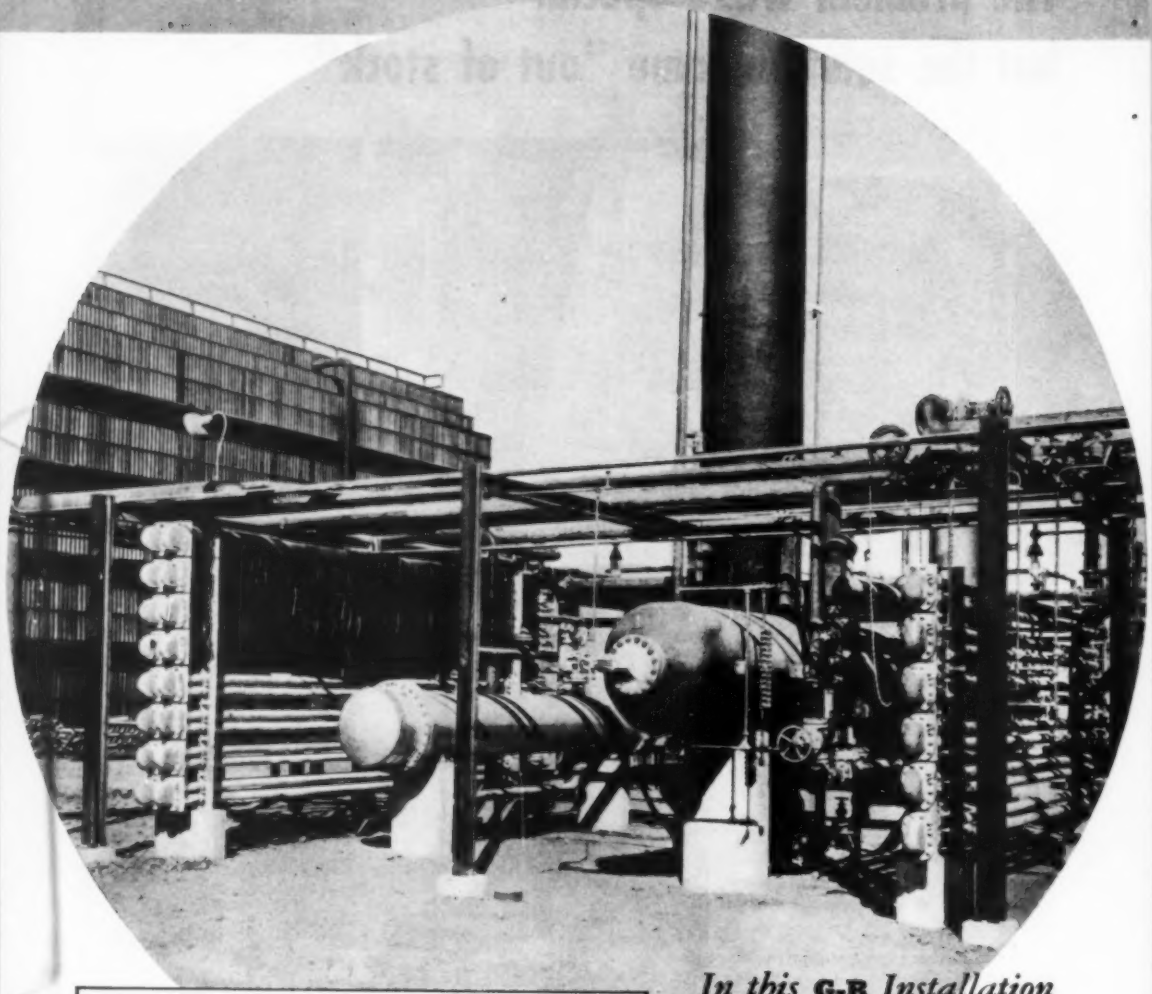


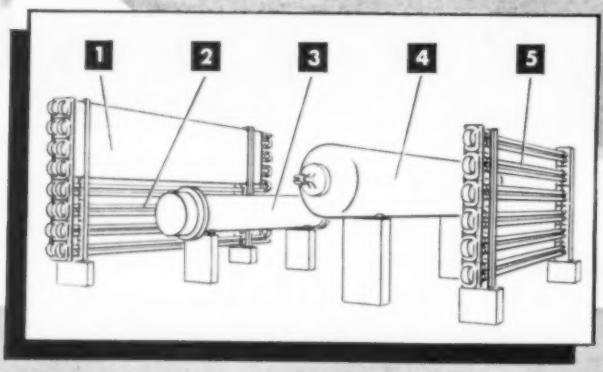
Tons of heater drain piping in the turbine room of the new Southwark station of the Philadelphia Electric Company had to be supported somehow. It had to be flexibly supported because of the travel between its "hot" and "cold" positions. The ceiling was sixty feet up so overhead suspension was out. Could it be supported from the floor? The problem had already been anticipated by Grinnell with their Pre-Engineered Spring Hanger fig. B268: type F, described in the new Grinnell Pipe Hanger Catalog 10D. This hanger is available in 14 sizes with a range of load capacities from 74 to 4800 lbs.

Plenty of other piping support problems are pre-solved economically for you in this combination catalog and manual . . . with ready-to-install hangers and supports . . . all available from conveniently located Grinnell warehouses. Why not write today for your copy of Catalog 10D?

GRINNELL

Grinnell Company, Inc., Providence, Rhode Island. Branches: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane





In this G-R *Installation*

1. 8 G-R Twin G-Fin Sections, serving as Stabilizer Exchanger
2. 8 G-R Twin G-Fin Sections, serving as Stabilizer Cooler
3. G-R Type FLT Tubular Stabilizer Condenser
4. G-R Type FSE Stabilizer Reboiler
5. 6 G-R Twin G-Fin Sections, serving as Naphtha Side-Cut Cooler

GRISCOM-RUSSELL · PIONEERS IN HEAT TRANSFER APPARATUS

G-R

HEAT TRANSFER APPARATUS Fully Serves a Stabilizer In This Installation

As shown in the illustration on the adjoining page, all the heat transfer apparatus required for the stabilizer at this representative refinery is of G-R design. The G-R units include cooler, exchanger, reboiler and condenser, and also naphtha side-cut cooler.

Many additional G-R units, not shown in the illustration, were also installed for other services here; for this refinery, like hundreds all over the country, standardized on G-R Heat Transfer Apparatus to assure most effective heat exchange and recovery throughout the plant.

Whatever may be *your* heat transfer requirements . . . whether standard or special . . . investigate G-R designs. The unequalled range of G-R apparatus, including both finned tube and bare tube heat transfer surfaces, provides an exactly suitable design for every service. Write for descriptive bulletins on units for services in which you are interested.

THE GRISCOM-RUSSELL CO.
285 MADISON AVE., NEW YORK 17, N. Y.

TYPICAL DESIGNS OF G-R HEAT TRANSFER APPARATUS

G-R Tubular Exchanger, available with many different designs of stationary and floating heads, and with exclusive service features

Sectional drawing of the G-R Twin G-Fin Section, the heat exchanger with a greater range of applications than any other design on the market

One of the designs of G-R Reboiler, available with bare tubes or K-Fin elements.

GRISCOM-RUSSELL

LEAD LINED EQUIPMENT

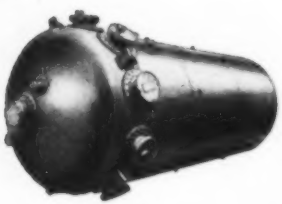
. . . curbs Corrosive Acids

The "vessels" used in the process industries may range from a five-gallon receptacle to a cavernous tank. Details of construction may differ. But, when it comes to handling corrosive chemicals, much of this equipment has at least one thing in common . . . a lining of lead. Because *Lead blunts the teeth of hungry acids.*

Leaders in the chemical processing field have something in common, too. They rely on the leader in lead products . . . National Lead . . . for their lead-lined and lead-covered equipment. They know that National offers . . . *and delivers* . . . not merely a mass of metal bearing outward resemblance to drawing and blueprint, but a piece of acid-handling apparatus that has the built-in ability to do the job it was bought to do. Into each unit goes the know-how, from drafting board to shop assembly, that makes the most of lead's resistance to chemical attack plus steel's resistance to physical abuse.

In National Lead's "Homogeneous" lead-lined tanks, drums, agitators, autoclaves and other items of this nature, the lead lining is bonded directly to the steel casing. An inseparable bond is created, a union of lead and steel that obviously will withstand higher temperatures than one in which solder is used.

Every piece of National Lead's "Homogeneous" lead-lined and lead-covered equipment is individually fabricated to your specifications. When you want information on acid-handling apparatus, please consider our specialists in this field *at your service.*



Look to the Leader for Lead

. . . in everything from lead pipe . . . valves . . . sheet . . . and lead-lined or lead-covered equipment . . . to complete acid recovery plants

NATIONAL

Lead Company

New York 6; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Company of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Philadelphia 25 (John T. Lewis & Bros. Co.); Atlanta (Georgia Lead Works, Div. of Cincinnati Branch); Toronto, Canada (Canada Metal Co. Ltd.).

Heating

by liquid circulation

An efficient, trouble-free system for high temperature heating service

Struthers Wells direct fired systems for heating by liquid circulation have been in use for over sixteen years. This system, including a tubular fired heater and pump circulated heating medium, has proven economical and trouble-free for high temperature heating service.

In addition to the heater, equipment supplied may include all necessary accessories to give a complete installation. Complete temperature control and safety devices are ordinarily included.

The heaters are shop assembled except for the largest sizes.

This equipment is widely used for heating reboilers, grease kettles, and high temperature conversion processes. The same heat transfer medium may be used for cooling if required in a batch process. The heater may also be used in services such as rich oil heating in gasoline plant work.

Heaters are available in a wide range of standard sizes, including small units for pilot plant operation. The equipment is supplied in all radiant design, or with extended surface convection section to give high thermal efficiencies.

Bulletin A-45 describing this equipment is available on request.

Struthers Wells

STRUTHERS WELLS

CORPORATION

Process Equipment Department

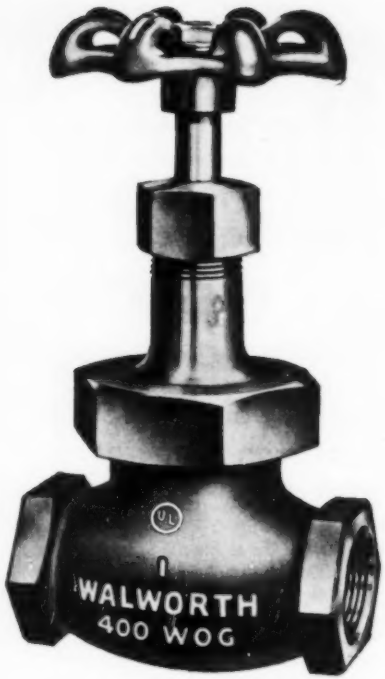
WARREN, PENNA.

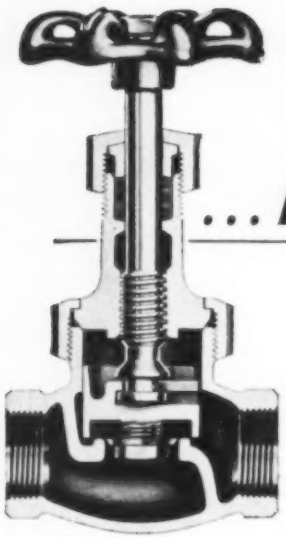
PLANTS AT WARREN, PENNA. • TITUSVILLE, PENNA.

OFFICES IN PRINCIPAL CITIES

Built for LP-Gas Service

Approved by Underwriter's Laboratories





... inside and out!

Walworth's No. 91 Bronze Globe and No. 92 Bronze Angle Valves are designed especially for liquefied petroleum gas service.

These valves have rising stems and union bonnets. The stuffing box has a gland and is packed with a special material suitable for LP-Gas service, which gives a free-turning valve stem without leakage. The valve can be repacked under pressure when fully opened.

The discs are made of a synthetic rubber-like material unaffected by liquefied petroleum. These discs are cemented to the holders and further secured by the usual disc nut. Disc holders can be removed and new ones inserted easily and quickly. If the valve is fully opened before the bonnet is removed, the disc holder cannot fall from the stem. The disc holder's special construction keeps the disc accurately guided under all installation positions.

These quality valves are rated and marked 400 pounds WOG. *They are approved by the Underwriter's Laboratories for Liquefied Petroleum Gas Systems,* and meet all safety regulations now prevailing in the industry, such as those published in pamphlet No. 58 of the National Board of Fire Underwriters.

For further information on these long-life, economical Walworth Bronze Valves see your nearby Walworth distributor, or write for Circular No. 100.

WALWORTH

valves and fittings

60 EAST 42nd STREET **NEW YORK 17, N. Y.**

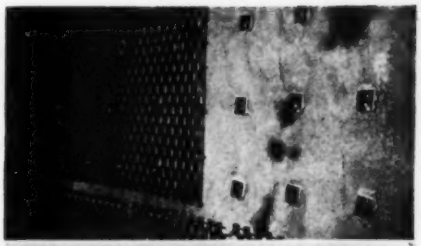
A. P. GREEN

SK-7 AND KS-4

TWO NEW REFRACTORY CASTABLES

DESIGNED AND ENGINEERED FOR "GUN" APPLICATION

IN THE PETROLEUM FIELD



Application of SK-7 completed. Steel mesh attached to studs preparatory to shooting KAST-SET KS-4.

KAST-SET KS-4 being applied by means of a cement gun. Note steel mesh which anchors KAST-SET KS-4 and provides abrasion-resistant wearing surface for Catalytic Regenerator lining.

Interior of Catalytic Regenerator showing the completed lining with the KAST-SET KS-4 applied over the CASTABLE No. 20 SK-7.

CASTABLE No. 20 SK-7 — a lightweight insulating castable recommended for a service temperature of 1800° F., and KAST-SET KS-4 — a castable refractory with a top service temperature of 2750° F. were designed specifically, for cement gun application in the Petro-Chemical industry. This modern method of applying refractory castables greatly reduces labor costs. The A. P. Green Company, a leader in the development and manufacture of high quality castable refractories for normal pouring application, had the experience and engineering know-how necessary in producing these modern pneumatically applied castables.

Continued research, experimentation and improvement have resulted in the development of these gun-applicable refractory castables which afford the same trouble-free service obtained from A. P. Green mix and pour castables. They have gained wide acceptance in the petroleum industry and are specified by several large companies in that field. The outstanding advantages available through the use of SK-7 and KS-4 are:

1. Installation time and labor costs are reduced considerably, because these materials can be applied quickly.
2. Construction costs are held to a minimum as no forms are necessary.
3. These castables are adaptable to a variety of installations, particularly in places where normal pouring castables cannot be used.
4. The objectionable feature of many gun-applied materials (high rebound loss) has been corrected by the special compounding of these products.
5. Shooting a lining with SK-7 or KS-4 results in a finished installation having the balanced characteristics of a poured castable.

These materials were designed for use wherever castable refractories are required and in places where the use of normal pouring castables is impractical.

For detailed information concerning these castable refractories, write the Engineering Department of the A. P. Green Fire Brick Company — or call your local A. P. Green Distributor.

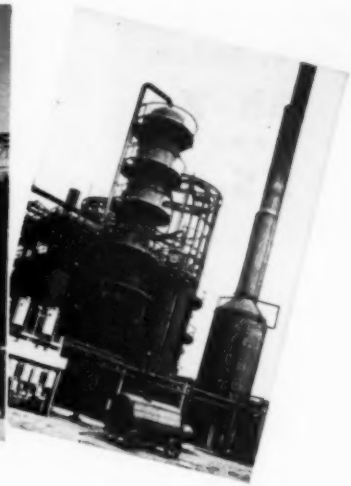
A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY

Mexico, Missouri, U. S. A.

A. P. GREEN FIRE BRICK CO., Ltd. in Canada

Representatives in the Principal Cities of the World



get Proved Performance *with* PERCO*

These four Perco Cycloversion* units prove the practical application of this simple, versatile process to current problems in petroleum refining. The unique flexibility of Perco Cycloversion makes it possible for each installation to handle any of three distinct jobs:

1. **Catalytic Desulfurization**—raises the leaded octane of straight run gasolines up to 10 numbers and cracked gasolines up to 5 numbers, dependent upon sulfur content, with no significant volume loss.

2. **Catalytic Reforming**—increases the Research and Motor octane ratings of both refinery and cycling plant gasolines with high yield-improvement factor.

3. **Catalytic Cracking**—cracks gas oils and distillates to yield high octane gasoline, olefinic gases and cycle stocks . . . minimizes fuel oil production.

*A SERVICE MARK

Reprints of recent articles covering operations of the four plants pictured are available upon request. Now is the time for *you* to investigate the many installation and operating advantages of this Perco process. Write us today. There is no obligation, of course.

Phillips Petroleum Company

PERCO PROCESSES

PERCO DIVISION • CHEMICAL PRODUCTS DEPARTMENT
BARTLESVILLE, OKLAHOMA

PROFIT WITH PERCO PROCESSES

KEEP EQUIPMENT ON STREAM

. . . with these Special Properties of Stainless Steels

STRENGTH . . . *at temperatures that would destroy ordinary metals* . . .

RESISTANCE TO ATTACK . . . from organic and mineral corrosive agents . . .

HIGH IMPACT VALUES to temperatures as low as −320° F.

These characteristics of austenitic chromium-nickel stainless steels help to save labor as well as time, and reduce costs by keeping equipment on stream.

Austenitic chromium-nickel stainless steels provide one of the strongest, toughest, and most economical means for extending the life of bubble towers, reactors, vapor lines and other vital equipment.

Investigate all the benefits stainless steels can give you. Leading steel companies produce austenitic stainless steels containing nickel in sheet, strip and all other commercial forms. A list of sources of supply will be furnished on request.

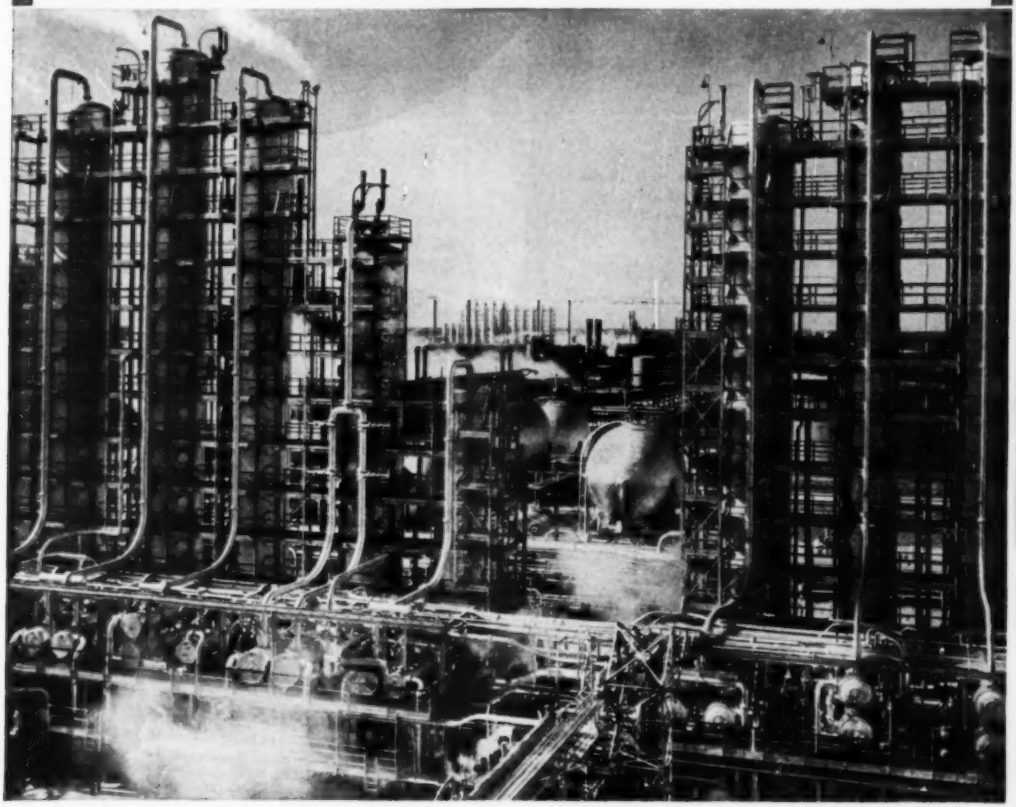


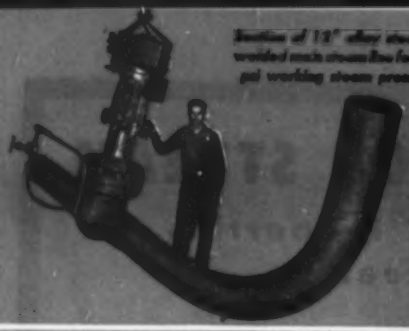
Photo courtesy of Standard Oil Co. (N. J.)

Don't Forget... Jot down — "INCO Booth, No. 302" — in your memo book of companies to visit at the **NATIONAL METAL EXPOSITION,** at the Public Auditorium in Cleveland, Ohio, October 17th to 21st. Convenient facilities for discussing your problems with our metallurgists and foundry specialists will be available.

INCO BOOTH NO. 302

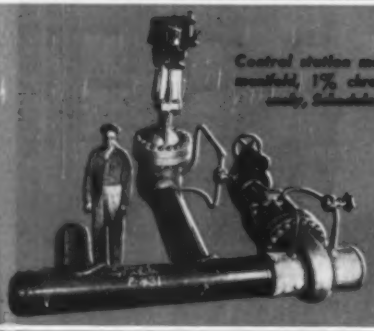
THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET NEW YORK 5, N.Y.

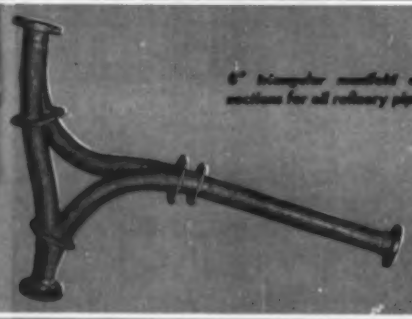


Section of 12" alloy steel all-welded main steam line for 900 psi working steam pressure.

Pump discharge header for glass furnace circulating water system.



Central station main steam manifold, 1¾ chrome, ½% moly, Schedule 160.



6" triangular manifold connections for oil refinery piping.

Bleeder piping manifold for steam turbine fabricated from 24" and 20" pipe and Midwest Welding Fittings.

YOU SAVE Time and Money IN ERECTION by Using MIDWEST PREFABRICATED PIPING

Midwest Prefabricated Piping is precision piping . . . that is why it saves time and reduces the cost of field erection. Being contractors as well as fabricators, we know from long experience the importance of having the subassemblies accurate to dimension and alignment. Before shipment from any of the four modern Midwest shops, pieces are checked for dimensional accuracy and thoroughly cleaned to remove scale and dirt by turbinizing or acid pickling as may be specified. Careful inspection and pressure testing are other characteristics of Midwest Prefabricated Piping methods.

Another important reason for the ease of erection and economy of Midwest piping is the fact that the difficult operations are performed in the fabricating plant and field welding is simplified. Here again our extensive erection experience enables us to effect savings by locating field joints where they are easy to make.

You will find it to your advantage to use Piping by Midwest . . . it saves time, money and trouble.

MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and South Boston • Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. South Boston 27—426 First St.

4 PLANTS ARE BETTER THAN 1

3478

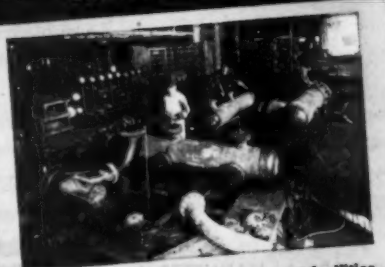
CHECKING DIMENSIONS AND ALIGNMENT

The careful check given every prefabricated subassembly before it leaves any Midwest shop saves time and trouble in field erection.

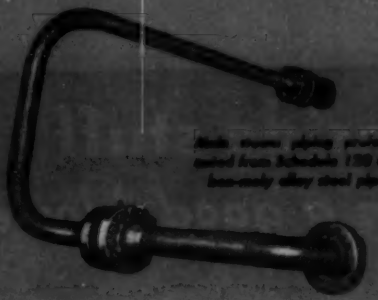
THOROUGH CLEANING

Prefabricated subassemblies are thoroughly cleaned before shipment from any Midwest plant and are turbinized when specified.

CAREFUL TESTING



All Midwest plants have complete facilities for testing piping assemblies to assure their ability to withstand the most severe operating conditions.



Male steam piping prefabricated from Schedule 160 seamless alloy steel pipe.

Process piping subassembly prefabricated from 10" Grade "A" seamless steel pipe.

Header for natural gas pipe line heated to 1400 psi.

Prefabricated subassembly of 24" OD x ½" wall seamless steel pipe for oil refinery.

Low pressure steam header fabricated from 6" and 3" pipe and Midwest Welding Fittings.

Inside stuff *on a good blower*

The blower casing, backplate, inlet connection, and guide vanes, all stationary parts in contact with the medium being handled, are normally made of cast Meehanite. When operating conditions, such as temperature or corrosion, demand, any or all of these parts can be made of steel or nonferrous alloys. With the backplate separate from the base and bearing housing, the use of special alloy material is kept to a minimum.

The open type, one-piece impeller may be made of any material required by the service. Since the impeller is essentially free from end thrust, a relatively simple thrust bearing may be used. Another factor of prime importance is that, with the open type impeller, the packing box seals against blower inlet pressure only, minimizing the possibility of gas leakage to atmosphere.

Elliott centrifugal blowers, single and multi-stage, have a long record of exceptionally satisfactory service in industries requiring the moving of air or gas. Full details in Blower Bulletin P-7, at request.

P-1085

Impellers are balanced statically and dynamically, and are overspeeded well beyond maximum operating speed before assembly with the blower unit.

ELLIOTT COMPANY
***Centrifugal Blower Dept.*, JEANNETTE, PA.**
Plants at: Jeannette, Pa. • Ridgway, Pa.
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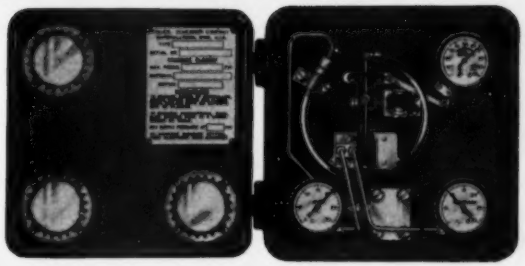
ELLIOTT *Centrifugal* BLOWERS

Your Favorite Dependable WIZARD...in a new gas-tight weather-proof case for flush or surface panel mounting



Type 4100U remote mounting Wizard with cover open.

FISHER WIZARD PILOT

SERIES 4100U

Side view Type 4100U for flush mounting.

Side view Type 4100U for surface mounting.

Universal case adapts Wizard to flush or surface panel mounting and also to valve yoke mounting.

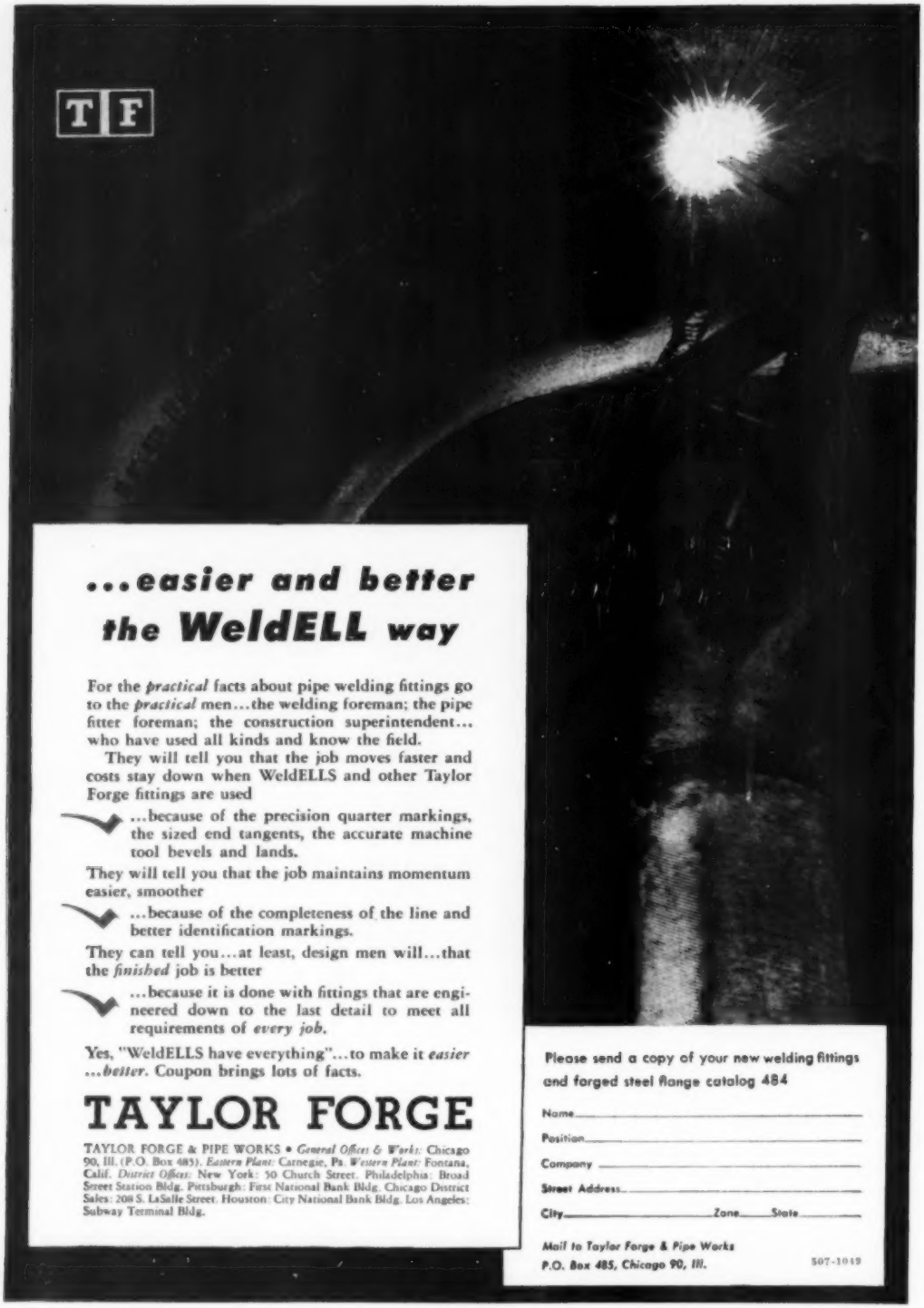
Available with either bellows or Bourdon tube measuring element, for pressures from inches W. C. to 10,000 PSI.

Simple knob adjustment for controlled pressure setting, indicated on calibrated dial.

WRITE TODAY FOR BULLETIN D4

FISHER GOVERNOR CO.

MARSHALLTOWN, IOWA



T F

...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job*.

Yes, "WeldELLS have everything"...to make it *easier ...better*. Coupon brings lots of facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS • *General Offices & Works:* Chicago 90, Ill. (P.O. Box 485). *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif. *District Offices:* New York: 30 Church Street. Philadelphia: Broad Street Station Bldg. Pittsburgh: First National Bank Bldg. Chicago District Sales: 208 S. LaSalle Street. Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg.

Please send a copy of your new welding fittings and forged steel flange catalog 484

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Mail to Taylor Forge & Pipe Works
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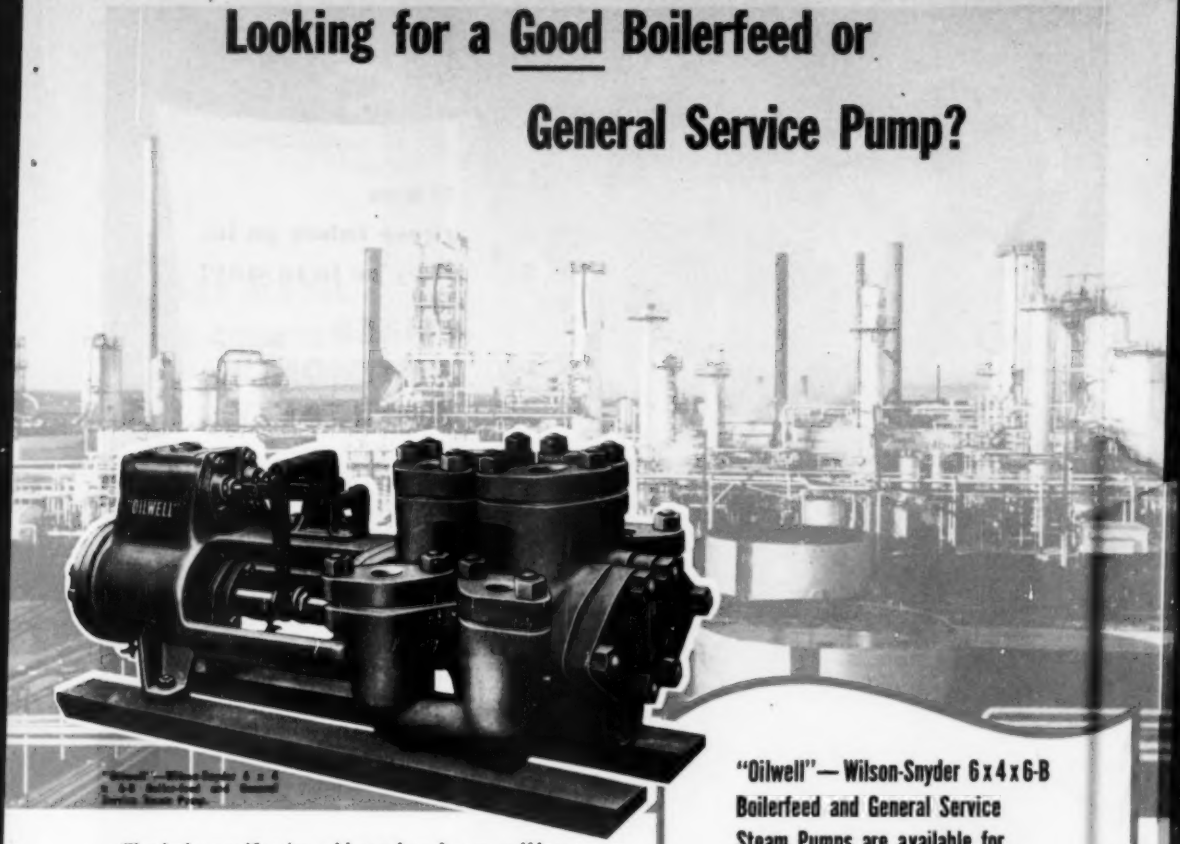
507-1049

Looking for a Good Boilerfeed or General Service Pump?



"Oilwell"— Wilson-Snyder 6 x 4 x 6-B Boilerfeed and General Service Steam Pumps are available for IMMEDIATE DELIVERY at all "Oilwell" Refinery Warehouse Points.

Check the specification tables and see for yourself how well this pump fits in with your plant requirements . . . then CALL "OILWELL."

BRIEF SPECIFICATIONS

THEORETICAL CAPACITIES IN G.P.M.—PISTON ROD DEDUCTED
(For Actual Capacity, Deduct Slip as shown Below)

Piston Size Inches	Disp. Per Rev Gallons	Displacement (Gallons per Minute)							
		20 RPM	30 RPM	40 RPM	50 RPM	60 RPM	70 RPM	80 RPM	90 RPM
3	.69	14	21	28	35	41	48	55	62
3½	.95	19	29	38	48	57	67	76	86
4	1.26	25	38	50	63	76	88	101	113
Slip		5%	5%	10%	10%	10%	10%	10%	10%

STALLING PRESSURES — Pounds per square inch

Piston Size Inches	Steam Pressure (Pounds per sq. in.)					
	100	150	200	250	300	350
3	400	600	800	—	—	—
3½	295	440	590	735	—	—
4	225	340	450	565	675	790

Working pressures are approximately two-thirds of the stalling pressures.

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THIS is the kind of boilerfeed and general service pump that can be depended upon for reliable, trouble-free service.

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And when such expendable parts as (1) fluid-end or steam-end rod packing, (2) fluid pistons (3) liners or (4) valve service must be replaced, you'll find them available at all times at your nearest "Oilwell" Refinery Warehouse.

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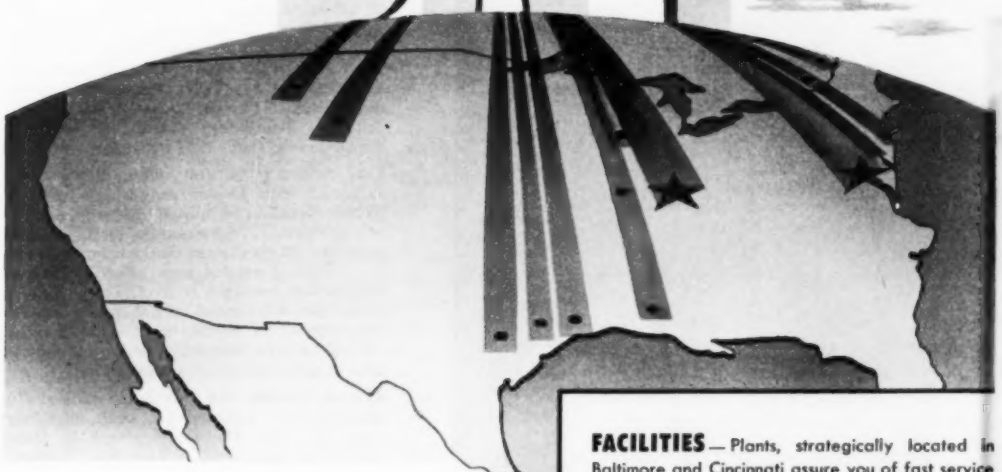
FLUID SYNTHETIC CRACKING CATALYST



Refineries specifying DA-1 (Synthetic Silica Alumina) are located in nearly every part of the country. Already, more DA-1 is used than any other catalyst of this type, and the number of users is increasing—influenced by the advantages offered by Davison's facilities, experience and service.

Davison's close laboratory control of production assures maximum catalyst utilization by maintaining a high standard of uniformity in physical, chemical and catalytic characteristics. DA-1 is available as . . .

F-1, FINE GRIND; C-1, INTERMEDIATE GRIND; C-2, COARSE GRIND

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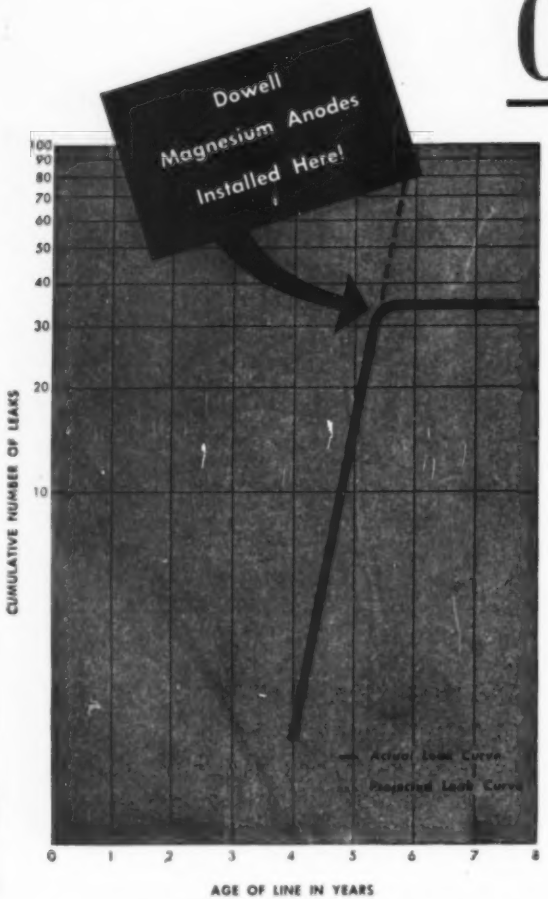

One way to lower pipeline maintenance costs is to reduce the number of leaks. The graph at left shows how a Gulf Coast city cut leaks in a 27 block, 2" galvanized piping system. The system was installed in 1940 and 1941. By April, 1946, leaks were appearing at an accelerated rate. *Then, magnesium anodes were installed!* Result: 2 leaks in the 30 days following installation and *no new leaks for the balance of 1946, 1947 and 1948!*

Cost-cutting protection such as this is being achieved with Dowell magnesium anodes. When corrosion of buried metal structures is a problem . . . for example, on oil and gas pipelines or municipal distribution systems . . . Dowell anodes may afford practical, economical corrosion control. The degree of protection will depend on soil conditions and the number of anodes used. Dowell magnesium anodes require no external power and maintenance is at a minimum.

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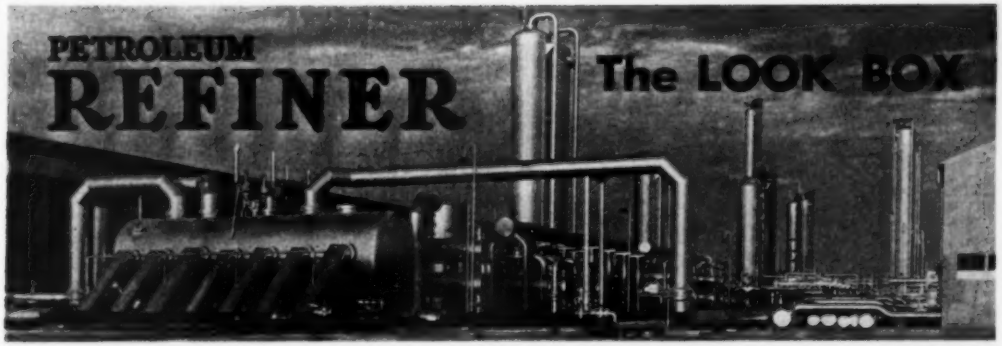


HOW many people are engaged in the petroleum industry?

Comes the answer from the Department of Information, American Petroleum Institute: 1,880,000 men and women. But, continues the statement, for each oil worker there are additional jobs for 4.2 workers in other industries that exist because of their direct dependency upon petroleum and its products.

Petroleum—Quite a Giant

The survey just completed shows that a total of 9,795,000 workers in the United States are employed by industries that are directly related to the petroleum industry. These workers and their families account for 34,282,000 men, women and children that are directly dependent upon these industries, and these comprise 23.3 percent of the total population of the United States.

Petroleum industry employes combined with those employed in directly related industries comprise more than 17 per cent of all persons gainfully employed in the United States. The figures are highly significant, since they emphasize the vastly important place in the nation's economy occupied by petroleum.

THE long range thinking and planning of engineering construction companies—gasoline, refinery, and petrochemical—is definitely optimistic, tempered with the realization that the lush days of great demands for plant construction by an oil industry starved for peacetime modernization and expansion are over. In other words, the construction division of the oil processing industry recognizes the slowing (in some instances, almost gratefully) of the immediate postwar construction boom. But it is looking forward to a normal and healthy peacetime business, which to the best of its estimating ability, can be achieved by the fall of 1950.

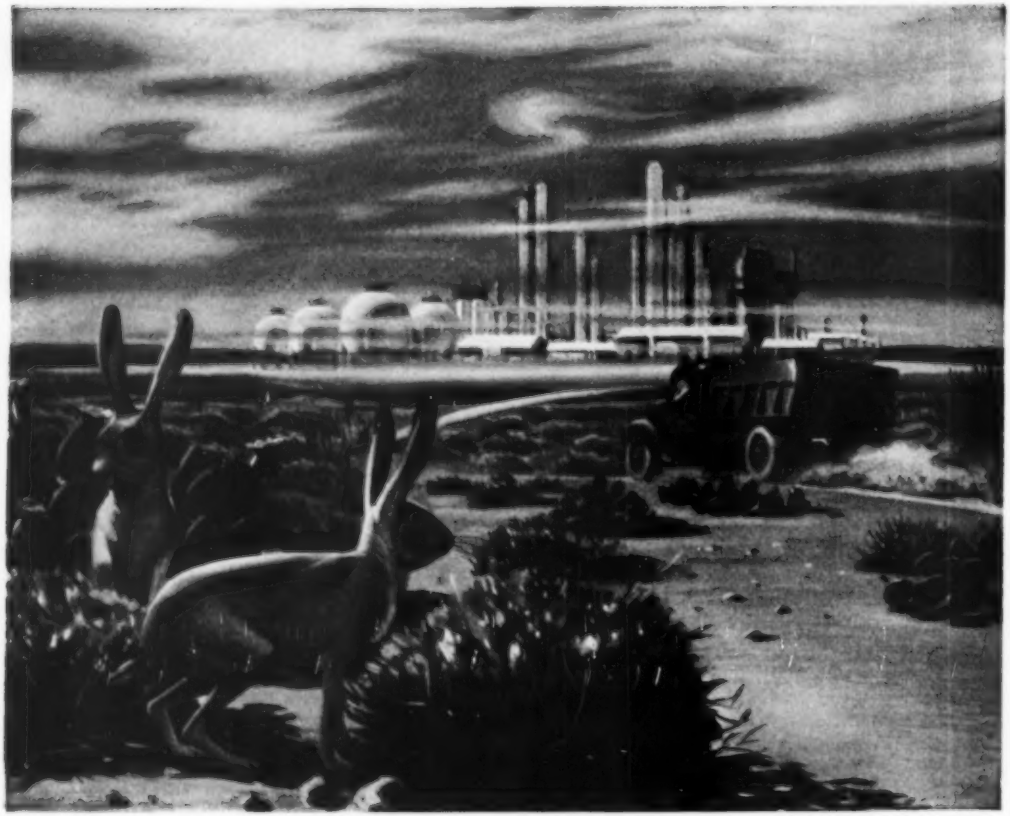
Plant Constructors Optimistic

According to the top officials of a large number of engineering construction companies both large and small, who were contacted by PETROLEUM REFINER, plans for the construction of new plants and the expansion of existing facilities for refining and natural gasoline processing, stopped almost completely during the spring and summer of this year. The sudden slump in construction planning did not arrive without indications of its coming to the constructors; thus, the slump is attributed, at least to a great extent, to a "taking stock of the situation" period by the operating companies.

There was a period, some construction companies point out, when practically no inquiries were made of them—the spring and summer of this year—but within the past eight weeks a variety of serious and active inquiries have been received. Since most of the construction companies continued to be quite busily occupied with projects started last year or earlier, the brief period when few bids were requested was, in many cases, not too serious a matter. One head of a company building process plants remarked that, "My company, until a few months ago, was building 13 plants simultaneously, and we are rather glad that the tempo has lessened." The construction industry, in general, believes that "the worst is over" and expects business to increase gradually until it achieves a normal competitive status sometime next year.

The natural gas-gasoline industry is about in the same position as the refining industry. Some of the engineering-construction companies queried in this field pointed out that their business was subject to the general economic trend of the country. They believe that after a readjustment period, sometime next year, business will approach a normal status. The advent of new construction companies is expected to make for highly competitive operation.

There is appreciable activity in the con-



CONSTRUCTION SPECIALISTS FOR THE *Southwest*

If there is an industrial frontier in America today, it certainly lies in the rich, bustling Southwest. Brown & Root, Inc., started here more than 30 years ago. Our long association with the terrain, soil, working conditions, and people of this vast empire has established Brown & Root as this section's foremost construction and engineering company. There is no substitute for experience, and if you have Southwestern plans, Brown & Root can help you.

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struction and extension of petrochemical plants just now, and quite extensive plans for future plants. Much of this activity is still in the economic study stage, so that serious plant design inquiries are not too frequent. The heavy expenditures required for these plants suggests that new plants in the future will be built on the basis of extensive pilot plant research work.

Curtailed buying of equipment was noted among some major companies a while back. According to a major manufacturer of oil industry equipment, however, equipment is being used up faster than it is being produced, and oil industry needs are high. Also, and most important of all factors, there has been no reversal of the long-term upward trend in the consumption of petroleum products. None appears likely. It is reasonable to expect that equipment sales will reflect the continued upward trend in product consumption.

Reliance on Petrochemicals

A REVOLUTION in the international demand and supply situation for industrial chemicals is seen by Dr. Robert S. Aires, New York consulting engineer, who last month told the Fuel and Energy section meeting, United Nations Scientific Conference on the Conservation and Utilization of Resources that heavy reliance of the world chemical industries is being placed on petrochemicals.

At present, one-third of the chemicals produced in the United States are based on petroleum or natural gas, Dr. Aires pointed out. "In contrast, less than 3 percent of the world chemical production is now based on such sources, the position in which the United States was approximately two decades ago," he said. "The trend, however, is distinctly in favor of petrochemicals. A large number of other countries are now installing petroleum chemical units, most of them being designed in the United States. Thus large scale production and potential exports can be expected from Great Britain (where two large units were recently started and two more are under construction), Canada, Sweden, France, Belgium, Italy and Spain. In addition to the above, several other countries including Mexico and Israel are seriously considering the possibility of putting up petrochemical installations.

"Since the United States is expected to be a petroleum importing nation, the cost of petroleum for chemicals will not be less than the cost in most of the other countries which are not importers, and may even be higher than in the oil producing countries, due to the absence of transportation costs. Thus the United States chemical industry is not expected to enjoy world markets in the future, to the same extent that it does at present, as it will neither have a cheaper raw material supply, nor better technology. In fact, some of the latest oil-cracking and conversion improvements are being incorporated in the ultra-modern plants abroad.

"Such a basic economic shift for petrochemicals should make an interesting study of the interrelationship of resources and technology. It may even be conceivable that with low tariffs, Europe may not only export chemicals to the rest of the world, but even to the United States, because of the lower cost of some of the other components of the price of chemicals, such as labor."

Petroleum's Research Activity

THE Petroleum industry is now spending almost four times as much on research as it did ten years ago, Dr. Wayne E. Kuhn, chairman of the American Chemical Society's Petroleum Division and manager of the Technical & Research Division of The Texas Company, reported last month to the society's 116th national meeting. The actual sum now being spent exceeds $100 million, he stated.

Enthusiasts have made the prediction that chemicals derived from oil may eventually outweigh in value the fuels, lubricants and greases derived from this resource. This is unlikely, but it reflects the growing importance of this phase of the industry's development, he pointed out.

Dr. Kuhn said that the plowback of earnings into research is increasing at a far faster rate than is that of the steel, chemical, electrical, lumber and wood products industries. Excluding the monies spent by the federal government for research of a controlled and regimented nature, the oil industry increase exceeds proportionately the growth of research by all industry.

The ratio of research expenditures to sales has almost doubled since 1939. Yet despite this steady increase in plowback of earnings, petroleum prices in 1948 were only 20 percent above the 1926 level —as compared with a commodity price increase of 60 percent, a food price increase of 80 percent, and a building material increase of 100 percent.

Dr. Kuhn said that the accomplishments of the industry are the direct result of our increasing knowledge of the chemistry of petroleum. The industry has already produced more than 5000 products and from the raw material itself more than a half million compounds have been made.

New technical bulletin, DISTILLATION ENGINEERING AND EQUIPMENT, is available on request.

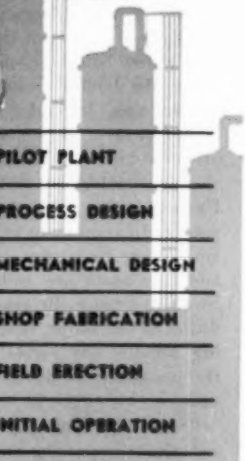
Distillation column of type 316 stainless steel measuring 56 feet in height, 10½ feet in diameter, having six shell sections.

distillation

processes and equipment for . . .

. . . the separation of hydrocarbons or other organic chemicals, should be designed for efficiency in terms of overall operating costs and amortization of capital investment. Tray efficiency, cleaning facility and resistance to corrosion are the principal factors to be considered. For practical purposes, tray efficiency or tray spacing may be reduced to keep tower cost at a minimum. A balance of utility costs against chemical recovery may indicate the desirability of sacrificing some of the recoverable material, with a corresponding reduction in the capital outlay for columns and associated calandrias, condensers and heat exchangers.

Particularly when potential changes in process or product specifications are foreseen, distillation columns with sectional shells and removable trays of light alloy construction offer special opportunities for economy because of the ease of transfer from tower to tower as well as cleanability and resistance to corrosion.



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Lube Oil Production Capacity And Its Relation to Demand

P. V. KEYSER, JR.
Manager Lubricating Oil Department,
Socony-Vacuum Oil Company, Inc., New York

(Excerpts from National Petroleum Association convention presentation)

REFINING facilities alone determine the maximum quantity of lubricating oils that can be made and this quantity always has been and will continue to be considerably below the potential in the crude. The essential nature of lubricating oil and the great additional quantity of raw materials from which lubricating products could be refined will always be powerful forces to assure the facilities that will produce a supply at least equal to the demand.

A picture of world lubricating oil production capacity and a comparison with anticipated demand is presented herein. The year 1948 will be used as a base and projecting both capacity and demand to the years 1950 and 1953. All the figures in the various tabulations and in the appendix are on the basis of 42-gallon (U. S.) barrels per day.

The figures shown for 1948 capacity are the production figures for that year. Estimates for 1950 and 1953 are formed by adding to the 1948 figures the estimated finished oil capacities of new facilities that will have been completed before the end of those years. By this method, figures do not comprehend capacity which, 1) may have been available but was not in use during 1948, which would tend to understate the results, and 2) conventional capacity to be retired on completion of new solvent facilities, the inclusion of which would tend to overstate the results.

The demand figures for 1948 are actual figures representing oil consumed. The estimates of demand for 1950 and 1953 have been built up from a variety of sources including estimates of motor vehicle registration in the United States, industrial activity in the United States, and a survey within each individual foreign country by our own Foreign Trade Department and others.

Table 1 shows the productive capacity within the United States, the internal United States demand, and the product available for export, actual for the year 1948, and projected on the basis outlined for the years 1950 and 1953.

TABLE 1

United States (42 gal. bbl. per day)

	Capacity	Demand	Available For Export
1948	141,000	98,000	*37,000
1950	178,000	94,000	84,000
1953	180,000	102,000	78,000

* Represents actual exports. In addition, 6,000 bbls. a day were added to inventories in the U. S. during 1948.

It is readily apparent that the expansion of our capacity will result in a substantial increase in the amount of lubricating oil available for export from the United States in the years 1950 and 1953.

Table 2 shows the estimates of foreign productive capacity and demand and, by difference, the demand on the United States from foreign sources for the three years under consideration.

TABLE 2

Foreign (Except U.S.S.R. and Satellites) (42 gal. bbl. per day)

	Capacity	Demand	Demand on U.S.
1948	28,000	65,000	37,000
1950	42,000	74,000	32,000
1953	82,000	87,000	35,000

It appears that increases in foreign capacity will only about keep pace with increases in foreign demand leaving a nearly constant requirement against the U. S. in face of a large increase in the quantity available for such export.

Table 3 summarizes the world capacity, world demand, and the excess of capacity over demand for the same years.

TABLE 3

World (Except U.S.S.R. and Satellites) (42 gal. bbl. per day)

	Capacity	Demand	Excess of Capacity Over Demand
1948	169,000	163,000	6,000
1950	220,000	168,000	52,000
1953	252,000	189,000	43,000

An analysis of world productive capacity and the internal demand by the respective countries is shown in the Appendix. (See page 83.)

It will be noted that in the year 1950, worldwide capacity will exceed demand by 52,000 barrels per calendar day, and in 1953 by 43,000 barrels per calendar day. However, in each of those years, although the United States will have a substantial oversupply, the balance of the world will continue to have a deficit of supply versus its own internal demand.

The Appendix differentiates between solvent extraction capacity and conventional capacity. It should be noted that all of the new capacity projected for 1950 and 1953, both in this country and abroad, is of the solvent type. It will further be seen that the ratio of solvent to total capacity in the United States will be at least 59 percent in 1953, whereas in the balance of the world it will be 50 percent.

Price levels for the various grades in the United States are presently depressed, being generally down to or below the prewar prices. On the other hand, recent experience indicates that prices for products produced in foreign countries are slightly to substantially higher than those prevalent in the United States. It is therefore apparent that, in spite of quality and in spite of price, the excess of capacity over demand will be brought into balance by the cutting back of refining largely within the United States.

It is reasonable to assume that, since it is estimated that there will be a large deficit of foreign refining capacity, there may be additional expansion of facilities outside the United States not included in these forecasts. This of course will simply further exaggerate the depressing effect upon operations in the United States. It is interesting to observe from the Appendix that even in the year 1953 there are only five countries in the world outside the United States which will produce more lubricating oil than they will require internally. In only one of these countries, namely Venezuela, is this excess sufficient to be an appreciable factor in the world market.

Our experience in the past 18 months has indicated that, although more passenger cars, trucks and other vehicles are operating, the consumption of lubricants by transportation units is declining. This is undoubtedly due to a number of factors, most important of which are the increasing proportion of new vehicles which consume less oil and the improving quality and durability of products. The consumption of lubricants in the industrial field is based upon industrial activity and it is the general prediction of economists that the level of U. S. industrial activity in 1950 will be from 5 percent to 10 percent below that of 1948 and, even in 1953, will probably not greatly exceed that of 1948. On the other hand, it is generally recognized that both transportation and industrial activity in foreign countries have not yet fully recovered and should continue to improve throughout the next few years. Actual foreign demands for 1950 and 1953 may deviate further from our estimates than will the internal demands of the United States. It is significant that, if foreign demand does not increase at the rate predicted, demand on the United States will decline further than has been forecast in Table 2.

The availability of the various currencies within any given country may have an appreciable effect upon the demand realized from that country. It is interesting to note from simple examination of figures on demand versus capacity of the respective countries that even in those countries which are generally construed to be sterling or soft currency, the internal capacity in 1953 will fall short of the internal demand within those countries by as much as 50 percent. It is difficult to appraise the exact source of crude which may be available to any of the known facilities, and the foregoing percentage estimate is only approximate but it is apparent that, if the block of countries referred to is to meet its normal demand, it must continue to import substantial quantities of product from dollar or other hard currency sources.

There are a number of important conclusions which can be drawn from the data and forecasts presented. There is no doubt whatever that world capacity will exceed world demand for many years to come. It is unfortunately obvious that the United States will for some years continue to be the country with the greatest surplus of capacity versus the demand on it, both for internal usage and for export. There is little doubt that lubricating oil production in the United States will operate considerably below capacity because of world oversupply. It is probable that curtailment will occur largely in conventional type operations, particularly in the older, less efficient units.

(See Appendix, Page 83)

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Make gasoline your top production item — for greater profits.

For GREATER PROFITS. . .

Every TRECO Unit has been a Money Maker for its owner.

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The REFINERY ENGINEERING Co.

Phone 5-5561 Tulsa, Oklahoma

Appendix (See discussion, page 81.)

TOTAL LUBRICATING OIL PRODUCTION CAPACITY AND ITS RELATION TO DEMAND—(42 Gal. Bbls. per day)

TABLE A—1950

	CAPACITY			Internal Demand	Surplus or (Deficit)
	Solvent	Conventional	Total		
WESTERN HEMISPHERE (EXCEPT U. S.):					
Alaska				137	(137)
Argentina		1,700	1,700	2,814	(1,114)
Bolivia				58	(58)
Brazil		100	100	1,778	(1,678)
Canada—Newfoundland	2,800	2,400	5,200	6,000	(800)
Canal Zone—Panama				60	(60)
Central America				233	(233)
Chile				438	(438)
Columbia	200		200	332	(132)
Cuba		70	70	458	(388)
Ecuador				66	(66)
Guianas (Br.-Fr.-Surinam)				38	(38)
Jamaica				47	(47)
Mexico		1,000	1,000	2,364	(1,364)
Paraguay				14	(14)
Peru		300	300	378	(78)
Puerto Rico				164	(164)
Trinidad & Tobago				112	(112)
Uruguay				145	(145)
Venezuela & N. W. I.	4,900	2,600	7,500	682	6,818
West Indies (Other)				118	(118)
Total Western Hemisphere (Except U.S.)	**7,900**	**8,170**	**16,070**	**16,436**	**(366)**
EASTERN HEMISPHERE (West of Suez):					
Marshall Plan Countries:					
Austria		300	300	685	(185)
Belgium-Luxemburg		150	150	1,453	(1,384)
Denmark				715	(715)
Eire				414	(414)
France	800	4,400	5,000	5,644	(644)
Germany (Western)	1,000	3,800	4,800	4,918	(118)
Greece				405	(405)
Iceland				69	(69)
Italy (Incl. Trieste)	800	400	1,200	2,301	(1,101)
Netherlands		2,000	2,000	1,260	740
Norway				647	(647)
Portugal & Islands		20	20	392	(372)
Sweden	350	250	600	1,353	(353)
Switzerland				575	(575)
Turkey				384	(384)
United Kingdom	4,450	3,600	8,050	15,000	(6,950)
Total Marshall Plan	**7,400**	**15,120**	**22,520**	**36,296**	**(13,776)**
Other Countries (West of Suez):					
Africa, West				548	(548)
Algeria				340	(340)
Canary Islands				33	(33)
Cyprus				30	(30)
Egypt				785	(785)
Finland				348	(348)
Gibraltar				8	(8)
Israel				175	(175)
Libya				71	(71)
Malta				19	(19)
Morocco, Fr.				304	(304)
Morocco, Sp.				30	(30)
Palestine—Transjordan				17	(17)
Spain				1,129	(1,129)
Sudan				49	(49)
Syria—Lebanon				167	(167)
Tunisia				159	(159)
Total Other Countires				**4,192**	**(4,192)**
Total Eastern Hemisphere (West of Suez)	**7,400**	**15,120**	**22,520**	**40,488**	**(17,968)**
EASTERN HEMISPHERE (East of Suez):					
Aden—Red Sea Area				63	(63)
Africa, East				293	(293)
Australia & Islands		500	500	2,937	(2,437)
Bahrein				3	(3)
Burma	1,000	500	1,500	203	1,297
Ceylon				148	(148)
China & Formosa				871	(871)
Hawaii				362	(362)
India & Pakistan	250	100	350	5,142	(4,792)
Indo-China				112	(112)
Iran				263	(263)
Iraq				30	(30)
Japan		800	800	2,934	(2,134)
Korea				Incl. in Japan	
Kuwait					
Malaya				345	(345)
N.E.I. Borneo—					
New Guinea				485	(485)
New Zealand				589	(589)
Philippines				562	(562)
Saudi-Arabia				30	(30)
Siam				137	(137)
Union of S. Africa				2,014	(2,014)
Total East Hemisphere (East of Suez)	**1,250**	**1,900**	**3,150**	**17,523**	**(14,373)**
Total Eastern Hemisphere	**8,650**	**17,020**	**25,670**	**58,011**	**(32,341)**
Total Foreign	**16,550**	**25,190**	**41,740**	**74,447**	**(32,707)**
United States	103,000	75,000	178,000	94,000	84,000
TOTAL WORLD	**119,550**	**100,190**	**219,740**	**168,447**	**51,293**

TABLE B—1953

	CAPACITY			Internal Demand	Surplus or (Deficit)
	Solvent	Conventional	Total		
WESTERN HEMISPHERE (Except U. S.):					
Alaska				151	(151)
Argentina		1,700	1,700	3,515	(1,815)
Bolivia				68	(68)
Brazil		100	100	2,128	(2,028)
Canada—New Foundland	2,800	2,400	5,200	6,531	(1,331)
Canal Zone—Panama				71	(71)
Central America				277	(277)
Chile				537	(537)
Columbia	200		200	362	(162)
Cuba		70	70	532	(462)
Ecuador				74	(74)
Guianas (Br.-Fr.-Surinam)				47	(47)
Jamaica				55	(55)
Mexico		1,000	1,000	2,841	(1,841)
Paraguay				16	(16)
Peru		400	400	562	(162)
Puerto Rico				200	(200)
Trinidad & Tobago				123	(123)
Uruguay				175	(175)
Venezuela & N.W.I.	4,000	2,000	7,500	959	6,541
West Indies (Other)				167	(167)
Total Western Hemisphere (Except U.S.)	**7,900**	**8,270**	**16,170**	**19,369**	**(3,219)**
EASTERN HEMISPHERE (West of Suez):					
Marshall Plan Countries:					
Austria		300	300	606	(306)
Belgium—Luxemburg		180	180	1,817	(1,667)
Denmark				781	(781)
Eire				460	(460)
France	3,000	4,400	7,400	6,576	824
Germany (Western)	2,300	4,300	6,600	6,603	(3)
Greece				521	(521)
Iceland				99	(99)
Italy (Incl. Trieste)	1,100	600	1,700	2,493	(793)
Netherlands		2,000	2,000	1,329	671
Norway				740	(740)
Portugal & Islands		20	20	404	(384)
Sweden	350	250	600	1,375	(775)
Switzerland				592	(592)
Turkey				518	(518)
United Kingdom	8,250	3,600	11,850	16,582	(4,732)
Total Marshall Plan	**15,200**	**15,820**	**31,020**	**41,896**	**(10,876)**
Other Countries (West of Suez):					
Africa, West				685	(685)
Algeria				382	(382)
Canary Islands	400		400	36	364
Cyprus				33	(33)
Egypt				822	(822)
Finland				447	(447)
Gibraltar				8	(8)
Israel				200	(200)
Libya				88	(88)
Malta				19	(19)
Morocco, Fr.				356	(356)
Morocco, Sp.				36	(36)
Palestine—Transjordan				22	(22)
Spain				1,277	(1,277)
Sudan				49	(49)
Syria—Lebanon				197	(197)
Tunisia				170	(170)
Total Other Countries	**400**		**400**	**4,827**	**(4,427)**
Total Eastern Hemisphere (West of Suez)	**15,600**	**15,820**	**31,420**	**46,723**	**(15,303)**
EASTERN HEMISPHERE (East of Suez):					
Aden—Red Sea Area				66	(66)
Africa, East				351	(351)
Australia & Islands	250	500	750	3,351	(2,601)
Bahrein				3	(3)
Burma	1,000	500	1,500	238	1,262
Ceylon				175	(175)
China & Formosa				1,011	(1,011)
Hawaii				403	(403)
India & Pakistan	250	100	350	6,068	(5,718)
Indo-China				140	(140)
Iran	750		750	307	443
Iraq				33	(33)
Japan		800	800	3,455	(2,655)
Korea				Incl. in Japan	
Kuwait					
Malaya				449	(449)
N.E.I. Borneo—					
New Guinea				512	(512)
New Zealand				710	(710)
Philippines				638	(638)
Saudi-Arabia				33	(33)
Siam				181	(181)
Union of S. Africa				2,419	(2,419)
Total East Hemisphere (East of Suez)	**2,250**	**1,900**	**4,150**	**20,743**	**(16,593)**
Total Eastern Hemisphere	**17,850**	**17,720**	**35,570**	**67,466**	**(31,896)**
Total Foreign	**25,750**	**25,990**	**51,740**	**86,855**	**(35,115)**
United States	105,000	75,000	180,000	102,000	78,000
TOTAL WORLD	**130,750**	**100,990**	**231,740**	**188,855**	**42,885**

AUTOMATIC

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SELF-ACTING

SELF-THINKING

CONTINUOUS PRESSURE

SPLIT-SECOND ACTION

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to seal Nordstrom valves automatically and continuously

Fully automatic lubrication for Nordstrom valves is here! Introduction of Rockwell *Hypermatic* lubricant marks the greatest advancement in the valve industry since the invention of Nordstrom valves 30 years ago. Hypermatic is the first and only genuine automatic lubricant.

Now you can make deep cuts in your valve maintenance cost because your lubrication crew need devote only 1/10, 1/20, 1/50, up to 1/100 as much time to re-lubrication.

Your Nordstrom valves will give better service with less cost because each one will be automatically maintained in a condition of 100% lubrication, even in event of considerable neglect.

Leakage will be prevented because Hypermatic both seals and lubricates with split-second action and positive certainty.

Unlike any other lubricant, Hypermatic is compressible and expansible. Self-powered energy is created within the lubricant merely by turning the lubricant screw or using a grease gun. This energy then serves as a powerful force-feed. Almost twice as much Hypermatic can be compressed into the valve's lubricant chambers. The pressure is retained, not for days, but for months, if the valve is not operated. If frequently operated, Hypermatic will retain its pressure for scores of turns longer than if non-automatic lubricant is used.

NOTHING TO BUY EXCEPT THE LUBRICANT

Instead of resorting to the use of extraneous devices or endeavoring to use variable line pressure, Hypermatic provides a new system of lubrication which gives the effect of a vastly improved valve design. You don't have to invest a single cent in mechanical devices. You don't even have to purge the old lubricant. Simply switch to Hypermatic and apply it to your present Nordstrom valves. It will displace the old lubricant.

Your Nordstrom valves will use less Hypermatic than non-automatic lubricant because Hypermatic creates, by its flexible nature, a "spring-action" which to a great extent prevents over-lubrication and under-lubrication.

IT COMPRESSES

Like the action of a door-check, Hypermatic compresses to a fraction of its volume when the lubricant is forced in. This stores up energy for future use.

ROCKWELL **Hypermatic** TRADE MARK **LUBRICANT**

PATENTS APPLIED FOR

IT EXPANDS

When the valve needs lubricant to seal a leak, its inherent energy forces it to expand and seal the valve seat. It feeds into any void instantly.

FOR NORDSTROM VALVES

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***Switch* to Hypermatic—stocks now available.**

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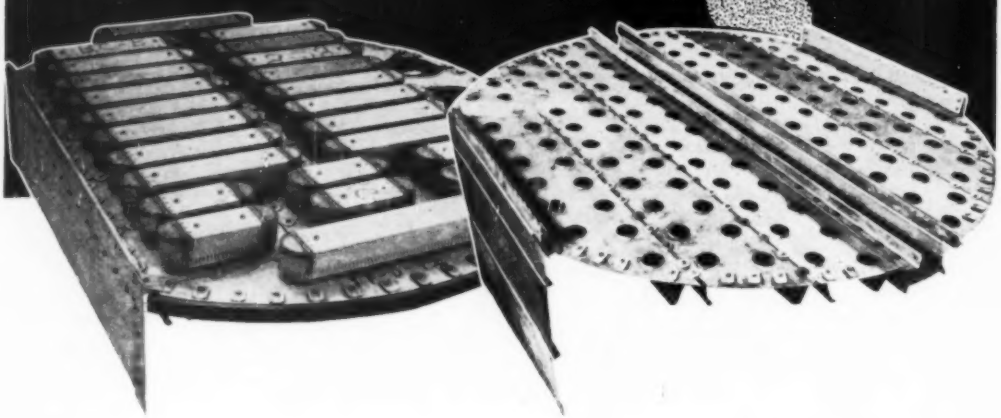

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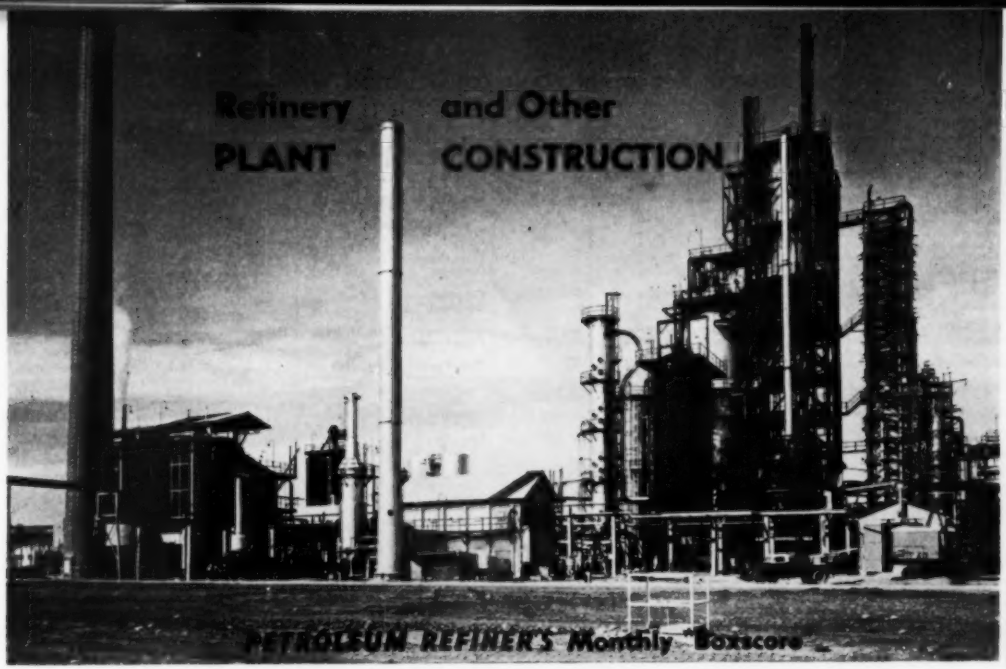


THE tabulation which follows is a regular feature which has proved invaluable to PETROLEUM REFINER readers. Over the two years which it has appeared, it has filled a definite need in the processing industry.

To the end that the tabulation appears correct and complete each month, readers are asked to 1) send in "boxscore" data (as called for by the column headings) on projects not listed; 2) furnish details which are missing in any item in the current tabulation and 3) report from time to time on the progress of these projects.

Address Editor, PETROLEUM REFINER, Box 2608, Houston 1, Texas.

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
EAST									
E. I. DuPont	Parkersburg, W. Va.	Tetrafluoroethylene Resin Plant			Under Constr.	Summer, 1950			
Esso Standard Oil Co.	Linden, N.J.	Vac. pipe still	40,000 bbls.		Completed			S.O.D. & Braun	Braun
Esso Standard Oil	Linden, N.J.	Cat. Crk. Lt. Ends	41,000 bbls.		Completed			S.O.D. & Braun	Braun
Esso Standard Oil	Bayonne, N.J.	Dewaxing	7,500 bbls.		Under Constr.	1st Qtr., 1950	Texaco	Badger	Badger
Esso Standard Oil	Linden, N.J.	Steam Boiler	260,000 lbs. hr.		Completed			S.O.D.	
Esso Standard Oil	Bayonne, N.J.	Steam Boilers	400,000 lbs. hr.		Under Constr.	2nd Qtr., 1950		S.O.D., Day & Zimmermann	S.O.D. & Zimmermann
Freeport Sulphur Co.	Westville, N.J.	Sulfur Recovery	40 tons		Contracted				Girdler
Gulf Oil Corp.	Philadelphia, Pa.	Topping,Vacuum	30,000 bbls.		Under Constr.	Nov., 1949		Lummus, Badger	Lummus
Pure Oil Co.	Savannah, Ga.	Lube Bld., Pkg.			Under Constr.	Nov. 1, 1949			
Quaker State Oil Refining Corp.	Emlenton, Pa.	Boiler Plant Add.	65,000 lbs./hr.	$100,000	Under Constr.	Nov., 1949			Staff
Socony-Vacuum Oil Co., Inc.	Paulsboro, N.J.	Crude, Dist. Unit	19,500 bbls.		Under Constr.	Fall, 1949		Badger	Badger
Socony-Vacuum	Paulsboro, N.J.	Propane Deasph.	5,950 bbls.		Under Constr.	Jan., 1950	Juik	Badger	Badger
Socony-Vacuum	Paulsboro, N.J.	MEK Dewaxing	2,050 bbls.		Under Constr.	Oct., 1949	Texaco	Badger	Badger
Socony-Vacuum	Paulsboro, N.J.	Light Oil Trtng.	28,000 bbls.		Designing	Dec., 1949		Badger	Badger
L. Sonneborn Sons	Petrolia, Pa.	Antipollution		$400,000	Under Constr.	1st Qtr., 1950		Chemico	Knowles
*Socony Vacuum	Paulsboro, N.J.	Mod. Compound, Pkg. Dept.	5,000 bbls.		Under Constr.	Jan., 1950		Staff	Staff
Sun Oil Co.	Marcus Hook,Pa.	Wax			Completed		Texaco	Staff	Staff
Sun Oil	Marcus Hook,Pa.	Comp. & Pkg.			Under Constr.	Nov., 1949		Staff, Lindsay	W. W. Lindsay
The Texas Co.	Beacon, N.Y.	Expand Research Labs.			Under Constr.	Dec. 1, 1949		Voorhees, Walker, Foley & Smith	
The Texas Co.	Westville, N.J.	New Refinery	40,000 bbls.		Under Constr.	Dec. 15, 1949		Foster Wheeler, Jackson-Moreland, Kellogg	Foster Wheeler, Kellogg
United Refining Co.	Warren, Pa.	Lab. Steam Gen.	60,000 lbs./hr.			4th Qtr., 1950			Union Iron Wks.
U.S. Dept. of Interior	Bruceton, Pa.	Fischer-Tropsch Pilot Plant	1-2 bbls.	$130,000	Under Constr.	Nov., 1949		Staff	Blaw-Knox Co.
MID-CONTINENT									
Ashland Oil & Refining	Canton, Ohio	Ref. Modern.							Cat. Constr.
Champlin Refining Co.	Enid, Okla.	Crude Unit	18,000 bbls.	$800,000	Under Constr.	Fall, 1949		Koch	Staff
Champlin Refining	Enid, Okla.	Cat Poly Unit	450 bbls.	$200,000	Under Constr.	Fall, 1949	U.O.P.	Koch	Staff
Cities Service, Del.	Cicero, Ill.	Compound Plt.	1,200 bbls.	$4 million	Contracted	July, 1950			Sollitt
Cooperative Ref. Assn.	Coffeyville, Kan.	Dewaxing	2,200 bbls.	$1.5 million	Contracted	Nov. 1, 1949	Texaco	Process Eng.	Process Eng.
Continental Oil Co.	Ponca City, Okla.	Crude Dist. Unit.	52,000 bbls.		Under Constr.	Oct., 1949		Bechtel	Bechtel
Deep Rock Oil Corp.	Cushing, Okla.	Cat. Cracker	5,000 bbls.		Under Constr.	Spring 1950		U.O.P.	J. & L. Constr.
The Derby Oil Co.	Wichita, Kans.	Cat. Crk. Change			Planning				
Dewese Oil Co.	Weston, Ohio	Lube Filtering	250 bbls.	$15,000	Under Constr.	1949		Staff	Staff
Ethyl Corp.	Ferndale, Mich.	Batch Gasoline Distil. Units	1 to 3 bbls.		Contracted	Sept., 1949			

Top of page photo affords view of Continental Oil Company's new $9,500,000 refinery at Billings, Mont., opened October 8. Left to right, are seen the boiler plant and stack, the crude furnace unit and tower and, the backbone of the refinery, the main catalytic cracking structure. (Also see photo page 174.)

• TABLE CONTINUED ON NEXT PAGE

REFINERY AND OTHER PLANT CONSTRUCTION (Continued)

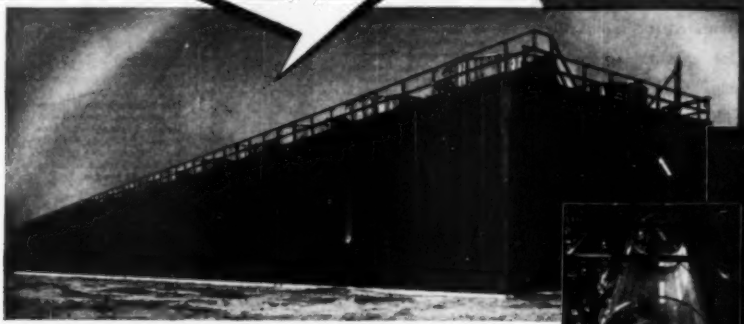
COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Globe Oil & Ref. Co.	Lemont, Ill.	Cat. Cracker	6,000 bbls.	$1 million	Buying Material	Jan. 1, 1950	U.O.P.	U.O.P.	
Gulf Oil Corp.	Kirby, Okla.	Gaso. Plant	14,500 mcf		Under Constr.				
Gulf Refg. Co.	Toledo, Ohio	Fluid Cat. Crk.	18,500 bbls.		Completed			Kellogg	Kellogg
Gulf Refg. Co.	Toledo, Ohio	Poly Unit	5,000 bbls.		Completed		U.O.P.	Kellogg	Kellogg
Gulf Refg. Co.	Cincinnati, Ohio	Fluid Cat. Crk.	18,500 bbls.		Under Constr.	Sept., 1949		Kellogg	Kellogg
Gulf Refg. Co.	Cincinnati, Ohio	Poly Unit	5,000 bbls.		Completed		U.O.P	Kellogg	Kellogg
Hoosier Gas Corp.	Vincennes, Ind.	Desulfo Unit	3,000 mcf.			Sept., 1949		Stacey, Dresser	
Indiana Farm Bureau Cooperative Assn.	Mt. Vernon, Ind.	Fluid Cat. Cracking Unit	4,000 bbls.		Design			U.O.P.	Staff
*Lever Bros. Co.	Hammond, Ind.	Hygirtol Plant	150,000 alf.		Under Constr.	Jan. 1, 1950		Staff	Girdler
Lion Oil Co.	El Dorado, Ark.	Ammonium Nitrate Prilling	400 tons	$1,200,000	Completed		Canadian Gov't.	Chem. Constr.	Blaw-Knox
Lion Oil	El Dorado, Ark.	Sulfuric Acid	360 tons	$1.25 million	Completed			Chem. Constr.	Chem. Constr.
Lion Oil	El Dorado, Ark.	Ammonium Sulfate Plant	360 tons	$730,000	Completed			Chem. Constr.	Chem. Constr., Blaw-Knox
M. F. A. Oil Co.	Chanute, Kans.	Desulfurization	1,000 bbls.	$75,000	Under Constr.	Oct. 15, 1949	Phillips	Koch	Koch
Magnolia Pet. Co.	Grant County, Kans.,(Hinkok)	Gasoline Plant	100,000 mcf		Under Constr.	Jan., 1950		Staff, Wahe	Wahe
Magnolia Pet.	Chitwood, Okla.	Pressure Maint. & cycling	24,750 mcf		Under Constr.	Dec., 1949		Staff, Constr. Service	Constr. Service
Magnolia Pet.	Stephens County, Okla. Kans.	Gasoline Plant	30,000 mcf		Under Constr.	Jan., 1950		Staff, J. & L. Constr.	J. & L. Constr.
Midland Cooperative Wholesale	Cushing, Okla.	Cat. Poly Unit	200 bbls.		Authorized	Early 1950			Ref. Eng. U.O.P.
Northern Nat. Gas.	Buston, Kans.	Inc. Comp. Cap.	1,400 hp.		Under Constr.	1949			Dresser
Northern Natural Gas Co.	Clifton, Kans.	Compressor Add.	1,800 hp.		Under Constr.	1949			Fluor
Northern Nat. Gas.	Mullinville, Kans.	Inc. Comp. Cap.	3,300 hp.		Under Constr.	1949			Dresser
Northern Nat. Gas.	Sublette, Kans.	Gasoline Plant	265,000 mcf		Authorized	1950			Pritchard
Northern Nat. Gas.	Sublette, Kans.	Increase Comp.	3,200 hp		Under Constr.	1949			Poor
Ohio Oil Co.	Robinson, Ill.	Vac., Cat Crk., Crd. Still, Poly, LPG Recov.	27,500 bbls.	$15 million	Completed		U.O.P.	McKee	McKee, Pritchard
Oklahoma Refg. Co.	Seminole, Okla.	Refinery	200 bbls.	$40,000		Oct., 1949			
Old Dutch Refg. Co.	Muskegon, Mich	Platforming Unit	2,000 bbls.		Under Constr.	Oct. 1, 1949	U.O.P.	U.O.P.	Staff
Petro Corp.	Blue Island, Ill.	Houdri., Cat. Crk., LPG Recov.	5,000 bbls.	$400,000	Under Constr.	4th Qtr., 1949	Houdry	Houdry	Clarke
Phillips Pet. Co.	Kans City, Kans.	Cat. Crack Cat. Poly	24,000 bbls. 1,500 bbls.	$10 million	Under Constr.	Nov., 1949		Braun	Braun
*Phillips Pet., et al	Edmond, Okla.	Absorp. Plt. Add.	60,000 mcf		Authorized	April, 1950			Ref. Maint.
The Pure Oil Co.	Toledo, Ohio	Revamp. Crd. Reform.			Under Constr.	1949			Cat. Constr.
Rock Island Refg. Corp.	Rock Island, Ind.	Fluid Cat. Crk.	10,000 bbls.	$1,200,000	Completed		U.O.P.	U.O.P.	Staff
The Shallow Water Refining Co.	Shallow Water, Kansas	Reforming Unit	1,250 bbls.	$85,000	Under Constr.	Fall, 1949	Pereo	Koch Eng.	Koch Eng.
Skelly Oil Co.	Eldorado, Kans.	Crd. Dist. Cat. Crk.	35,000 bbls.	$8-10 million	Under Constr.	Mid 1950			
Socony Vacuum	E. St. Louis, Ill.	Crude Distil.	15,000 bbls.		Under Constr.	Oct., 1949		Staff	Bechtel
Socony-Vacuum	E. St. Louis, Ill.	Thermal Crack	13,200 bbls.		Under Constr.	Jan., 1950		Staff	Bechtel
Socony-Vacuum	E. St. Louis, Ill.	Misc. Ref. Addn.			Under Constr.	Jan., 1950		Staff, Bechtel	Bechtel
Socony-Vacuum	E. St. Louis, Ill.	Delayed Coking	8,700 bbls.		Under Constr.	March, 1950		Staff, Bechtel	Bechtel
Socony-Vacuum	Augusta, Kans.	Houdry Conversion to T.C.C.	13,000 bbls.		Planned	Mid., 1950	Socony-Vacuum		
Socony-Vacuum	Trenton, Mich.	Houdry Conversion to T.C.C.	15,000 bbls.		Planned	Mid., 1950	Socony-Vacuum		
Standard Oil Co., (Indiana)	Whiting, Ind.	Outside Battery Limit Facilities			Under Constr.	1949		Fluor	Fluor
Standard Oil Co., (Ohio)	Lima, Ohio	Inc. Tank. Cap.	384,000 bbls	$240,000	Planning	May 1, 1950		Staff	Hammond
Standard (Ohio)	Lima, Ohio	Liquid Gas Fit.		$220,000	Planning	Dec. 31, 1949		Staff	Undetermined
Standard (Ohio)	Lima, Ohio	Furfural Refg.	76,000 gals	$13 million	Contracted	1951	Texaco	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Cat. Cracking	16,000 bbls.	$11 million	Under Constr.	Oct., 1949	U.O.P.	McKee	McKee
Standard (Ohio)	Lima, Ohio	Crd. Dist. Coke	†15,000 bbls.	$3.5 million	Authorized	Feb., 950	Kellogg	Kellogg	Kellogg
Standard (Ohio)	Lima, Ohio	Solvent Dewax.	1,800 bbls.		Authorized	Mid 1951	Texaco	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Vacuum Unit	9,000 bbls.		Authorized	Mid 1950			Lummus
Standard (Ohio)	Lima, Ohio	Propane Deasph.	800 bbls.		Authorized	Mid 1950			Lummus
Sun Oil Co.	Toledo, Ohio	Cat. Crack, Crude Dist., Vac., Poly	30,000 bbls.	$18 million	Under Constr.	Jan., 1950	Houdry	Houdry, Cat. Constr., Process Eng., Staff	Cat. Constr.
Sun Oil	Toledo, Ohio	Compressor Sta.	2,840 hp.		Designing			Fluor	
The Texas Co.	W. Tulsa, Okla.	Expand, Modernize Refinery	20,000 bbls.	$15 million	Under Constr.	Dec. 15, 1949		Kellogg, Foster Wheeler, U.O.P.	Kellogg, Foster Wheeler
The Texas Co.	Lawrenceville, Illinois	Expand Refinery	†20,000 bbls.		Design	April 1, 1951		Foster Wheeler, Kellogg	Foster Wheeler, Kellogg
Tide Water Associated Oil Co.	Drumright, Oklahoma	Houdriflow Unit Cat. Cracker	4,500 bbls.		Under Constr.	Late, 1949	Houdry		Process Eng.
U. S. Dept. of Interior	Louisiana, Mo.	Demonstration Oil-from-Coal	80 bbls.	$5 million	Under Constr.	Dec., 1949		Koppers	Koppers
West Cement Medrano Unit	Caddo County, Oklahoma	Gas Injection Facility	9,000 mcf	$1 million	Completed			Dresser	Dresser
Wood River Oil & Refining Co., Inc.	Hartford, Ill.	Fluid Cat. Cracker	7,500 bbls.	$2.5 million	Under Constr.	Dec., 1949	U.O.P.	Koch	Staff
Wood River Oil R.	Hartford, Ill.	Vacuum Unit	13,000 bbls.	$700,000	Under Constr.	1949		Koch	Staff
SOUTHWEST									
Alba Refg. Co.	Alba, Texas	Asphalt Refining	1,500 bbls.	$125,000	Under Constr.	Nov. 1, 1949			
*Amarillo Oil Co.	Exell, Texas	Compressor Sta. Exten.	600 hp.		Under Constr.	Oct., 1949		Staff	Bowden
*Amure Oil Corp.	No. Coleman County, Texas	Gas-Injection	300,000 cf		Postponed				
Barnsdall Oil Co.	Placedo, Texas	Compressor Sta.	2,000 hp.	$380,000	Under Constr.	1949		Olsen	Olsen
Brazos River Gas Co.	Mineral Wells, Texas	Gasoline Plant	15,000 mcf		Completed			R. L. Purvin & Richard Henry	
Calumet Refg. Co.	Princeton, La.	Blending Oil Tank House	700 bbls.		Under Constr.	1st Qtr., 1950		Staff	Stafff
Carthage Hydrocol, Inc.	Brownsville, Texas	Hydrocol	87,000 mc	$26 million	Under Constr.	Dec., 1949	Hydro-Res., Inc Texaco	McKee, Hydro-Res., Inc.	McKee
Cit-Con Corp.	Lake Charles, La.	Lube Plant	6,000 bbls.	$42 million	Completed		Texaco Max B. Miller	Max B. Miller, Lummus	Lummus, Max B. Miller
Cities Service Oil	Chico Field, Tex.	Natural Gasoline	22,000 mcf		Designing	Early, 1950		Fluor	Fluor
Cities Service Oil	St. Rose, La.	Lube Oil Blending	1,800 bbls.	$750,000	Under Constr.	Late 1949		Day & Zimmerman	Day & Zimmerman
Coastal Refineries, Inc. & Mayfair Minerals, Inc	McAllen, Texas	Cycling Plant	75,000 mcf		Under Constr.	Mar., 1950		Gaso. Plant	Gaso. Plant
Continental Oil Co.	McAllen, Texas	Gaso. Plant	20,000 mcf	$1.5 million	Under Constr.	Dec., 1949			J. & L. Constr.
Continental	Big Lake, Todd (Deep) Field, Texas	Gas Recovery Plant	10,000 mcf	$3 million	Under Constr.	Nov. 1, 1949		Ref. Maint.	Ref. Maint.

• CONTINUED ON PAGE 91

WCEC

FOR THE WORLD'S LARGEST LUBE PLANT

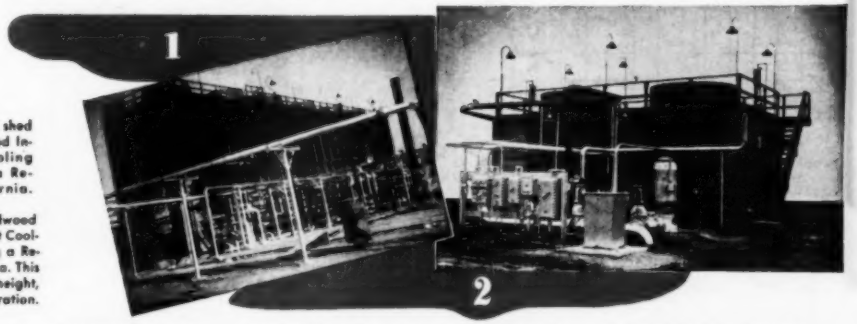
COOLING TOWERS are handling the toughest jobs in the PETROLEUM INDUSTRY



The world's largest...51,000 gals. of water per minute... 3,060,000 gals. per hour...73,440,000 gals. of water per 24-hour day...cooled to a guaranteed temperature with this 34-cell Multi-Stage, Redwood Induced Draft Cooling Tower, engineered especially for Lube Plant in Louisiana.

Is 48-in. in diameter, banded at regular intervals.

SERVING THE SPECIALIZED NEEDS OF REFINERIES EVERYWHERE



1. Six-Cell, coil shed type, Redwood Induced Draft Cooling Tower serving a Refinery in California.

2. Two-Cell, Redwood Induced Draft Cooling Tower serving a Refinery in Oklahoma. This Tower is low in height, economical in operation.

ADVANCED ENGINEERING DESIGN MEANS SUPERIOR PERFORMANCE

WCEC Cooling Towers today are being designed and built to handle any specified service demanded by any specific industry. In the Petroleum field, for instance, WCEC has designed and engineered a Cooling Tower meeting the specialized needs of the World's Largest Lube Plant. What we have done for them, we can do for you.

WATER COOLING EQUIPMENT COMPANY

FABRICATING PLANTS • • • ARCATA, CALIFORNIA • • • HOUSTON, TEXAS • • • ST. LOUIS, MISSOURI

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Here is the Diaphragm Motor with

GREATER POWER for GREATER ACCURACY

The far-advanced K&M Diaphragm Motor is designed for the more exacting needs of modern process industries. An unusually high power-factor is obtained by the carefully-engineered relationship of large effective diaphragm area and heavy, calibrated spring; friction is negligible, inner valve positioning more precise. The diaphragm is specially designed for constant affinity with the button contour; this assures a uniform effective area throughout the complete valve stroke, thus more uniformly accurate control. The unusually large area of the diaphragm in relation to the valve size also helps assure more precise control.

K&M motors are available for direct action or reverse action without change in effective area or stroke.

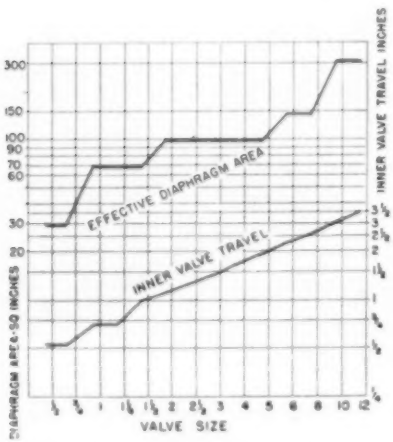
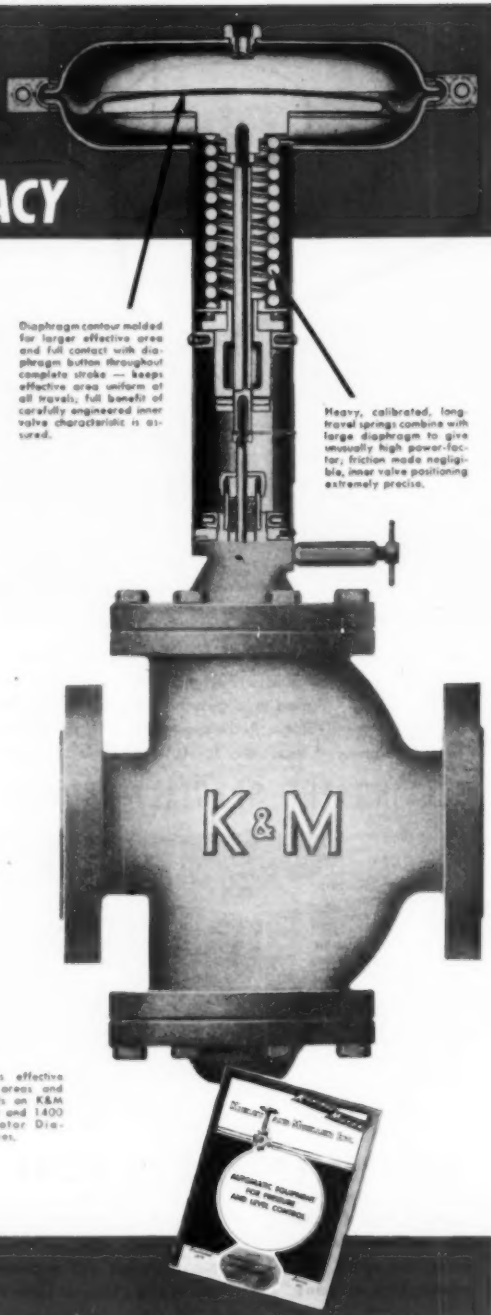


Chart shows effective diaphragm areas and valve travels on K&M Series 1200 and 1400 Kontrol Motor Diaphragm Valves.


Diaphragm contour molded for larger effective area and full contact with diaphragm button throughout complete stroke — keeps effective area uniform at all travels; full benefit of carefully engineered inner valve characteristic is assured.
Heavy, calibrated, long travel springs combine with large diaphragm to give unusually high power-factor; friction made negligible, inner valve positioning extremely precise.
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KONTROL KIELEY & MUELLER MOTOR

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You should have a copy of Kieley & Mueller Catalog 47. Over 100 pages describe the entire modern K&M line: Kontrol Motor Diaphragm Valves, Kontrol Master Liquid Level Controls and Pressure Pilots and related equipment for steam, gas, air, oil and liquid service. Please request on your business stationery.

REFINERY AND OTHER PLANT CONSTRUCTION (Continued)

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
*Continental & Assocs.	Near Nordheim, DeWitt County, Texas	Gas Comp.	12,000 mcf	$1 million	Planning	Dec., 1949	None	Process Eng.	Process Eng.
Conden Pet. Corp.	Big Spring, Tex.	Fluid Cat. Plant	6,000 bbls.	$2 million	Under Constr.	Nov., 1949	U.O.P.	U.O.P.	Ref. Eng.
Del Rey Petroleum Co.	Chesterville, Colorado County, Texas	Pressure Absorption Plant	25,000 mcf	.....	Under Constr.	.....	.....	O. L. Olson	Ole Olson
Department of the Army	Houston, Texas	Anhydrous Ammonia Facility	2,100 tons monthly	$2.5 million	Relocating	Oct., 1949	.....	Girdler Corp.	Hercules Powder Co.
Dow Chemical Co.	Freeport, Texas	Ammonia Plant	100 tons	$5 million	Planning	Late ,1950	.....	.....	.....
El Paso Natural Gas Co.	Mobane Field, Texas	Gasoline Plant	16,700 mcf	.....	Designing	Nov., 1949	.....	Fluor	Staff
El Paso Natural Gas	Mobane Field	Treating Plant	.....	.....	Designing	Late, 1949	.....	Fluor	Staff
*El Paso Nat. Gas	Moore County, Texas	Compressors	10,600 hp.	$1.8 million	Under Constr.	Jan., 1950	.....	Staff	.....
*El Paso Nat. Gas	Moore County, Texas	Gas Dehydration Adds.	130,000 mcf	$55,000	Under Constr.	Jan., 1950	.....	Stearns-Roger	Staff
*El Paso Nat. Gas	Castro County, Texas	Compressor Sta.	4,050 hp.	$1.1 million	Under Constr.	Jan., 1950	.....	Staff	Staff
*El Paso Nat. Gas	Crane County, Texas	Compressor Sta.	4,400 hp.	$1.27 million	Under Constr.	Jan., 1950	.....	Staff	Staff
*El Paso Nat. Gas	Ector County, Texas	Compr. Unit	3,200 hp.	$350,000	Under Constr.	Jan., 1950	.....	Staff	Staff
E. I. DuPont de Nemours Co., Inc.	Victoria, Texas	Chemical Intermediates for Nylon	.....	.....	Design	Early 1951	.....	Staff	Staff
Esso Standard Oil Co.	Baton Rouge, La.	Mechanical Shops, Main Office, Cafeteria, Crude Desalting Unit	.....	.....	.....	Sept., 1949 Mid., 1950	.....	Braun, Harris, Bodman & Murrell, Staff	Braun ,Harris, Staff
Ethyl Corp.	Baton Rouge, La.	Mfg. Facilities	.....	$40 million	Under Constr.	Oct., 1949	.....	Stone & Webster	Stone & Webster
B. F. Goodrich Chemical Co.	Port Neches, Texas	Expand Plant	.....	$800,000	Completed	.....	.....	Staff	Carruth Constructing Co.
Gulf Oil Corp.	Crane, Texas	Gasoline Plant	40,000 mcf	.....	Completed	.....	.....	Braun	Braun, W. H. Bowden
Gulf Oil	Port Arthur, Texas	Revamp Houdry Fixed-Bed Units	10,000 bbls.	.....	.....	Oct. 1, 1949	Houdry	Cat. Constr. Co.	Cat. Constr. Co.
Humble O&R Co.	Katy, Texas	Add Propane, Absorption, Refrigeration	Unchanged	.....	Under Constr.	Oct., 1949	.....	Stearns-Roger	Stearns-Roger
Humble O&R	Conroe, Texas	Absorption	80,000 mcf	.....	Under Constr.	Oct., 1949	.....	Stearns-Roger	Stearns-Roger
Humble O&R	Opelousas, La.	Absorption	110,000 mcf	.....	Under Constr.	Oct., 1949	.....	Hudson	Hudson
Humble O&R	Baytown, Texas	Roof Replacing of Butyl Bldg.	.....	.....	Under Constr.	.....	.....	Staff	Staff
Humble O&R	Baytown, Texas	Miscl. Facilities	.....	$1 million	Projected	.....	.....	.....	.....
Humble O&R	Jourdanton Field, Texas	Gasoline Plant	26,000 mcf	.....	Under Constr.	Early 1950	.....	.....	Hudson
Humble O&R	Tomball Field, Texas	Add Compression Facilities	10,000 mcf	.....	Under Constr.	Oct., 1949	.....	Fluor	Fluor
Jefferson Chem. Co., Inc.	Austin, Texas	Central Research Facilities	.....	.....	Under Constr.	Sept., 1949	.....	Staff	Staff
Jefferson Chem.	Pt. Neches, Tex.	Inc. Cap.	.....	.....	Shut Down	.....	.....	Staff	.....
Lone Star Gas	Dallas, Texas	Hypersorption	60 mcf	.....	Design & Eng.	1949	Union Oil Co.	Foster Wheeler	Foster Wheeler
Magnolia Pet.	Seeligson Field, Premont, Tex.	Gasoline Cycling, Casinghead	150,000 mcf Cycled 70,000 mcf Casinghead	.....	Under Constr.	Nov., 1949 Sept., 1949	.....	Hudson	Hudson
Mayfair Minerals	McAllen, Tex.	Cycling Plant	50,000 mcf	.....	Under Constr.	Mar., 1950	.....	Gaso. Plant	Gaso. Plant
Midland Gasoline Co.	Conroe, Texas	Enlarge Gasoline	100,000 gals.	.....	Under Constr.	Dec., 1949	.....	Gaso. Plant	Gaso. Plant
Northwestern Refining Co.	St. Paul Park, Minn.	Loading Rack, Products Transfer Line	500,000 gals.	$40,000	Under Constr.	Jan., 1950	.....	Staff	Staff
Pan American Refining Corp.	Texas City, Tex.	Revamping Crude Unit	.....	.....	Engineering	Late 1949	.....	Tellepsen	Tellepsen
Panhandle Pro. & Refg.	Leudera, Texas	Refinery	1,200 bbls.	.....	Shut down	.....	.....	.....	.....
Panhandle Producing & Refining Co.	Wichita Falls, Texas	Cat. Cracker	1,500 bbls.	$1 million	Under Constr.	Jan. 1, 1950	U.O.P.	U.O.P., J. & L. Constr.	J. & L. Constr.
Phillips Chemical	Etter, Texas	Prod. of Nitric Acid	225 tons	.....	Under Constr.	Nov. 1, 1949	Chemico	Chemico	Brown & Root
Phillips Chemical	Etter, Texas	Fertilizer Plant	300 tons	.....	Under Constr.	Oct., 1949	Chemico	Chemico	Brown & Root
Phillips Chemical	Borger, Texas	Increase Cap. Phil-black Carbon Black Plant	8 million lbs./yr.	.....	Under Constr.	Dec., 1949	.....	Staff	.....
Phillips Chemical Co.	Etter, Texas	Inc. Cap. Cactus Ammonia Plant	440 tons	$5.3 million	Under Constr.	Sept., 1949	Chemico	Chemico	Brown & Root
Plymouth Oil Co.	Rankin, Texas	Gas Compression, Absorp.	70,000 mcf	$5½ million	Under Constr.	1949-50	.....	.....	Hudson
The Pure Oil Co.	Dollarhide, Andrews County, Texas	Nat. Gasoline Plant	22,000 mcf	$6 million	Under Constr.	July, 1950	.....	.....	.....
The Pure Oil Co.	Nederland, Tex.	Wax Fractntn.	200 bbls.	.....	Under Constr.	Sept., 1949	Texaco	Lummus	Lummus
Reno Oil Co.	Holiday, Texas	Gaso. Press. Maint. Plt.	400 hp.	.....	Under Constr.	Sept., 1949	None	O. L. Olson	O. L. Olson
Shamrock Oil & Gas Co.	Sunray, Texas	Inc. Top., Crk.	10,000 bbls.	$300,000	Under Constr.	3rd Qtr., 1949	U.O.P.	Staff	Staff
Shell Oil Co.	Houston, Texas	Lube Utilities	.....	.....	Under Constr.	1949	.....	Fluor	Fluor
Shell Oil Co.	Provident City, Texas	Gas Stripping	60,000 mcf	.....	Under Constr.	1st Qtr., 1950	.....	Fluor	Fluor
Shell Oil Co.	Notrees, Texas	Add TXL Plant	30,000 mcf	.....	Under Constr.	Early 1950	.....	Brown & Root	Brown & Root
Shell Oil Co.	Denver City, Texas	Gas Comp. Absorp. Add.	30,000 mcf	.....	Under Constr.	Late 1949	.....	Fluor	Fluor
Skelly Oil Co.	Skellytown, Tex.	Add Gaso. Plant	.....	.....	Completed	.....	.....	.....	J. E. Carlson
Southern Minerals Corp.	Stratton Field, Texas	Gas Compression addition	.....	.....	Under Constr.	.....	.....	.....	.....
Stanolind O&G Co., Opr.	Fullerton Field, Texas	Gasoline Plant	55,000 mcf	.....	Under Constr.	Jan . 1950	.....	J. & L. Constr.	J. & L. Constr.
Stanolind O&G.	Brownsville, Tex.	Chemical Plant	50 mln tons/yr	.....	Under Constr.	Jan. 1, 1950	.....	Badger	Badger
Stanolind O&G.	Levelland, Tex.	Gasoline Plant	40,000 mcf	.....	Under Constr.	Feb., 1950	.....	Brown & Root	Brown & Root
Stanolind O&G.	N. Cowden, Tex.	Gasoline Plant	50,000 mcf	.....	Under Constr.	1950	.....	Stearns-Roger	Stearns-Roger
Sun Oil Co.	Starr Co., Tex.	Gasoline Plant	35,000 mcf	$4 million	Under Constr.	Sept., 1949	Pet. Eng.	Pet. Eng.	Pet. Eng.
Sun Oil	Chambers County, Texas	Compressor Plant	14,000 mcf	.....	Under Constr.	Dec., 1949	.....	.....	Pritchard
Sun Oil	Egan, La.	Compressor Plts.	10,000 mcf	$400,000	Authorized	1950	.....	.....	.....
Tex. Natl. Gas Corp. & Slick-Urschel	Rankin, Texas	Nat. Gasoline Plant	55,000 mcf	.....	Under Constr.	Nov., 1949	.....	Tex. Natl. Gas Corp.	Pritchard
The Texas Co.	Tijerina-Canales Field, Texas	Gas Compression	6,000 mcf	.....	Under Constr.	Oct., 1949	.....	.....	.....
The Texas Co.	Chalk-Hill Field, Texas	Gas Compression, Absorp.	2,000 mcf	.....	Under Constr.	1949	.....	.....	.....

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REFINERY AND OTHER PLANT CONSTRUCTION (Continued)

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
The Texas Co.	Withers Field, Texas	Expand Compression	9,000 mcf		Completed			Telegram	Telegram
United Gas Pipe Line Co.	Karnes City, Texas	Natural Gas & Cond. Proc.	10,000 mcf.	$1 million	Under Constr.	Jan., 1950		Delta	Delta
West Texas Gas Co.	Fritch, Texas		3,150 B. hp.		Completed			Staff	
ROCKY MOUNTAIN									
American Gilsonite Co.	Bonanza, Utah	Gilsonite-to-Crude-Oil Pilot	200 tons	$300,000	Under Constr.	1949		Staff	Staff
The Carter Oil Co.	Billings, Mont.	Crude Cat. Crk.	30,000 bbls.	$15 million	Under Constr.	3rd Qtr., 1949		U.O.P., S.O.D., Fluor	Fluor
Continental Oil Co.	Billings, Mont.	Complete Ref. Cat. Crack	7,500 bbls.	$9.5 million	Under Constr.	Oct. 8, 1949	U.O.P.	U.O.P., J. & L. Constr.	J. & L. Constr.
Coronado Gas Corp.	Loco Hills Field, N. M.	Repressuring, Extraction	10,000 mcf	$500,000	Under Constr.	Sept., 1949	P. M. Raigorodsky	Pet. Eng.	Pet. Eng.
Coronado Gas.	Artesia, N.M.	Enlarge Plant	10 million gals.	$400,000	Under Constr.	Oct. 1, 1949	Pet. Eng., Inc.	Pet. Eng.	Staff
*El Paso Nat. Gas	Lea County, N. M.	Compressor Sta.	3,500 hp..	$1.35 million	Under Constr.	Jan., 1950		Staff	Staff
*El Paso Nat. Gas		Gas Purif. Plt.	50,000 mcf	$325,000	Under Constr.	Jan., 1950		Stearns-Roger	Staff
*El Paso Nat. Gas		Gaso Absorp. Plt.	50,000 mcf	$285,000	Under Constr.	Jan., 1950		Stearns-Roger	Staff
Empire State Oil Co.	Thermopolis, Wyo.	Crude, Vacuum	5,000 bbls.	$325,000	Under Constr.	1949		Ref. Eng.	Ref. Eng.
Northern Natural Gas Co.	Palmyra, Neb.	Compressor Add.	1,600 hp.		Under Constr.	1949			Fluor
The Pure Oil Co.	Worland, Wyo.	Gasoline Plant			Projected				
Salt Lake Refining Co.	Salt Lake City,	Cat. Cracking	25,000 bbls.	$10 million	Design	Jan., 1951		Bechtel-Houdry	Bechtel
Skelly Oil Co.	Lea County, N. M.	Expand Gaso. Plt.	60,000 gals.		Completed				J. E. Carlson
*Sesony-Vacuum Oil Co.	Casper, Wyo.	Topp. Revisions	5,900 bbls.		Under Constr.	Fall, 1949		Staff	Cat. Constr.
Southern Union Gas Co.	Bloomfield, N. M.	Gas-dehydration Unit	60,000 mcf	$40,000	Under Constr.	Sept., 1949		Graf	
Texas Gulf Sulphur Co.	Worland, Wyo.	Sulfur Recovery, Gas Treating Plants	30,000 mcf		Under Constr.			Girdler, C. F. Braun, Foster Wheeler	Girdler
WEST COAST									
General Pet. Corp.	Torrance, Calif.	H_2S Absorption			Engineering	Jan., 1950		Badger	Badger
General Pet. Corp.	Torrance, Calif.	Noded Spheroid	2 million gal.	$400,000	Under Constr.	1949		Staff	C.B.&I.
General Pet. Corp.	Torrance, Calif.	Cooling Tower	8,400 gal.		Under Constr.	1949		Staff	Fluor & Staff
General Pet. Corp.	Torrance, Calif.	Chemical Treat.	2,000 tons		Under Constr.	Late Fall, 1949		Staff	Staff
General Pet.	Torrance, Calif.	Two Coke Druma, Furnace	7,500 bbls.	$2.25 million	Under Constr.	Early 1950		Kellogg	Bechte
Hancock Chemical Co.	Long Beach, Cal.	H_2S Recovery	50 tons	$1 million	Designing	Jan., 1950		Badger	Badger
Hancock Oil Co.	Long Beach,	Ethylene Glycol	60,000 lbs.		Engineering	3rd Qtr., 1950		Badger	Badger
Ohio Oil Co.	S. Colen, Levee, Calif.	Gas Lift	1,800 hp.		Under Constr.	1949		Fluor	Fluor
Paloma Refining Co.	Paloma Field, Calif.	Extend Absorption Sect.	60,000 mcf		Planning				
Richfield Oil Corp.	Cuyama, Calif.	Absorption, H_2S Removal	15,000 mcf		Under Constr.	1949		Fluor	Fluor
Richfield Oil Corp.	Cuyama, Calif.	Comp., Plt. Extn.	2,040 hp.		Designing	1949		Fluor	Fluor
Shell Oil Co.	Wilmington, Cal.	Add. Crk. Comp.			Under Constr.	1949		Fluor	Fluor
Southern Counties Gas Co.	Blythe, Calif.	Add. Compressor Capacity		$350,000	Under Constr.	Oct. 21, 1949	None	Mel-Mar	Gill
Standard Oil Co. of Calif.	Bakersfield, Calif.	Ther. Crk. Gaso. Stabil., T.	9,000 bbls.		Under Constr.	Late 1949	U.O.P.	U.O.P.	Braun
Standard Oil, Calif.	Bakersfield,	Crude Dist.	10,000 bbls.	$7.7 million	Under Constr.	Nov., 1949	Braun	Braun	
Union Oil of Calif.	Brea Olinda, Cal.	Research Plant		$5 million	Projected	Sept., 1950			
Union Oil Co. of Calif.	Oleum, Calif.	Asphalt Refined Oil Loading		$457,000	Under Constr.	Sept., 1949		Early Constr.	Early Constr.
Union Oil Co. of Calif.	Oleum, Calif.	Revise Refg.		$4 million	Under Constr.	Oct., 1949		Parsons, E. & A.	Ref. Maint.
Union Oil Co. of Calif.	Oleum, Calif.	Improve handl. ing facilities		$1.5 million	Under Constr.	Dec., 1949		Matheves Conveyor Co., J. M. Montgomery & Co.	Early, C. N. Peterson, Mathews Conveyor
Union Oil Co. of Calif.	Oleum, Calif.	Duo-Sol Unit	6,000 bbls.	$3 million	Under Con	Sept., 1949	Max Miller	Max Miller	Max Miller
Union Oil Co. of Calif.	Oleum, Calif.	Tankage and Utilities		$1.8 million	Engineering	1st Qtr., 1950		Parsons	Eaton & Smith, Chicago Bridge & Iron Works, Utah Constr. Co.
Union Oil of Calif.	Oleum, Calif.	Main Office Addition, Shops, Misel.		$1 million	Under Constr.	4th Qtr., 1949		Austin, Field & Fry, D. R. Warren Co., J. M. Montgomery & Co.	E. S. McKittrick, Parker, Steffens & Pearce
FOREIGN									
Canada									
British American Oil Co., Ltd.	Montreal East, Quebec	Crd. Oil Top., Decarboniing	14,500 bbls.		Completed		Kellogg	Kellogg	Kellogg
British American Oil Co., Ltd.	Montreal East, Quebec	Cat. Crk., Poly.	13,300 bbls.		Under Constr.	4th Qtr., 1949	Kellogg-U.O.P.	Kellogg	Kellogg
Excelsior Refgs., Ltd.	Lloydminster, Alberta	Cap. Increase	3,000 bbls.		Under Constr	1950	U.O.P.	U.O.P.	
Excelsior Refineries	Lloydminster, Al.	Moving Refinery	3,000 bbls.	$500,000	Completed		U.O.P.	U.O.P.	
Hi-Way Refineries, Ltd.	Saskatoon, Saskatchewan	Crude Topping Unit	2,000 bbls.		Under Constr.	Dec., 1949	U.O.P.	Ref. Eng.	Ref. Eng.
Hi-Way Refineries,	Saskatoon,	Thermal Crack.	500 bbls.		Under Constr.	Dec., 1949	U.O.P.	Ref. Eng.	Ref. Eng.
Imperial Oil, Ltd.	Edmonton,	Add Capacity	15,000 bbls.	$2.5 million	Completed			Staff, Barnes	Barnes
Imperial Oil, Ltd.	Leduc Field	Gas Absorption	24,000 mcf	$0.5 million	Under Constr.	Mid. 1950		Braun	Braun
Imperial Oil.	Regina, Saskatchewan	Add Distil. Equip.	3,000 bbls.	$380,000	Under Constr.	Jan., 1950		Staff	Staff
Panther Oil and Grease Co.	Leaside, Toronto, Ontario	Grease and Compounding			Projected				
Shell Oil Co. of Canada, Ltd.	Montreal East, Quebec	Fluid Cat. Crk., Vac. Flash, Gas Recov., Poly, Treat.	35,000 bbls.		Under Constr.	Late 1950		Staff	Fluor, Ltd., McKee
Latin America									
Conselho Nacional do Petróleo	Mataripe, Bahia, Brazil	Thermal Cracking Refinery	5,000 bbls.	$2.5 million	Under Constr.	Jan., 1950		Kellogg	Kellogg, Staff
Creole Pet. Corp.	Amuay, Bay, Venezuela	Crude Stills	60,000 bbls.	$175 million	Under Constr.	1950		S.O.D.	Foster Wheeler J. G. White
Creole Pet. Corp.	El Roble Field, Venezuela	Repressuring			Planning				
Ipiranga S.A. cia Brasileira de Petroleos	Rio Grande, Brazil	Topping, Thermal Cracking	3,000 bbls.		Authorized	1952	Foster Wheeler		

■ CONTINUED ON PAGE 95

AUTOMATIC CONTROL EQUIPMENT

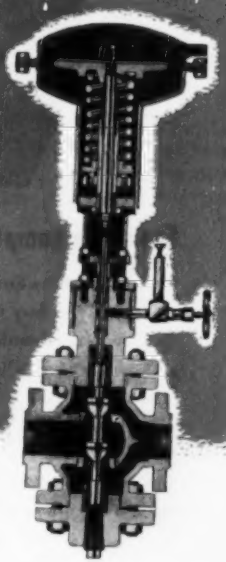
ENGINEERED DESIGN BY **HAMMEL-DAHL**

Comparison proves . . . . . HAMMEL-DAHL

"The World's Finest Control Valve"

STANDARD CONTROL VALVE SPECIFICATIONS	HAMMEL-DAHL	MAKER A	MAKER B	MAKER C
ALLSTEEL Superstructure	YES	NO Cast iron	NO Cast iron	NO Cast iron
Valve Stem Travel Stops	YES	YES	NO Valve stem only Travel stop	NO Valve stem only Travel stop
Ollite Spring Stem Guides	YES	NO Ball bearings	NO None	NO Roller bearings
Stainless Steel Spring Stem	YES	NO	NO	YES
Ball Bearing Spring Adjustment	YES	NO None	YES	YES
Superstructure Bolted to Valve Body Bonnet	YES	NO Locking collar on stuffing gland	NO Set screws	YES
Bolted Stuffing Box All Sizes	YES	NO Optional—extra charge	NO Optional—extra charge	NO Optional—extra charge
Thru Bolted Bonnets & Blind Heads—2" & up	YES	NO Blind studded	NO Thru studded	NO Blind studded
Hardened Stainless Steel Honed Plug Guide Bushings in Cast Iron & Steel Valve Bodies	YES	NO Steel bodies only	NO Optional—steel bodies	NO Steel bodies only
Valve Action Reversible No additional parts	YES	YES	NO	YES
A.S.A. Standard Face to Face Dimensions	YES	NO	NO	NO

STANDARD CONTROL VALVE SPECIFICATIONS



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YES, only Hammel-Dahl Flo-Tested Diaphragm Control Valves include all these Standard Control Valve Specifications. Consult our Engineers on your next Control Valve problem. Specify "Hammel-Dahl" and be sure of years of satisfactory service.

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HOUSTON KINGSPORT, TENN. LOS ANGELES NEW YORK PITTSBURGH SAN FRANCISCO
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In Canada: Railway & Power Engineering Corporation Ltd.

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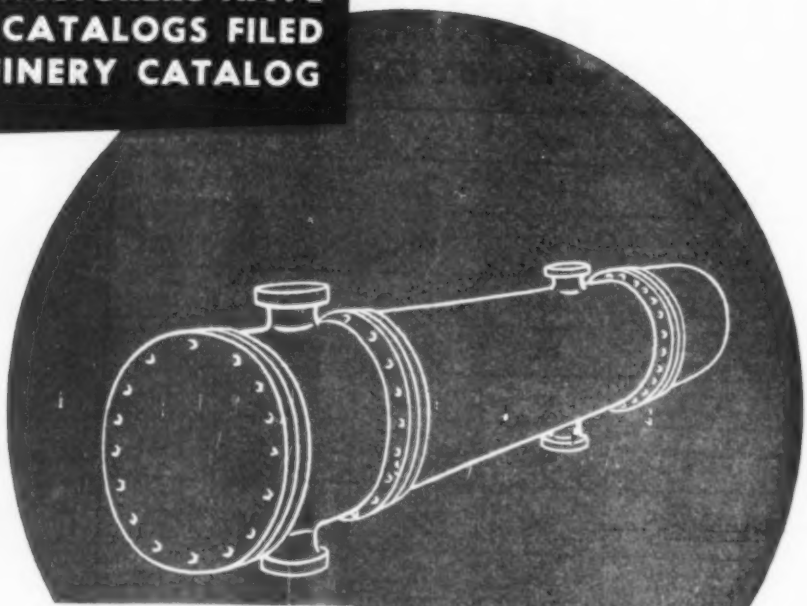

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REFINERY AND OTHER PLANT CONSTRUCTION (Continued)

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Mene Grande Oil Co.	Puerto la Cruz, Venezuela	Refinery	30,000 bbls.	.....	.....	.....	.....	.....	.....
Petróleos Mexicanos	Poza Rica, Mex.	Gas Purification, Pressure Maint.	.....	$13 million	Contracted	Early, 1950	.....	McKee	McKee
Petróleos Mexicanos	Salamanca, Mex.	Crd., Gasoil, Crk.	23,000 bbls.	$12 million	Under Constr.	Early, 1950	U.O.P.	McKee	McKee
Refinaria de Petróleo do Distrito Federal S.A.	Rio de Janeiro, Brasil	Complete Refinery	45,000 bbls	.....	Authorized	.....	.....	.....	Fives, Lille, Schneider, Staff
Refinaria e Exploraeno de Patróleo	Capuava, S. Paulo, Brasil	Thermal Cracking Refinery	20,000 bbls.	.....	Authorized	.....	.....	Pan American Hydrocarbon Res., Inc.	Czech, Plat. Metal Work & Mech. Constr.
Richmond Exploration Co.	Bajo Grande, Venezuela	New Refinery	35,000 bbls.	.....	Engineering	June, 1950	.....	.....	.....
Shell Oil of Venezuela	Punta Cardon, Venezuela	Comprehensive Refining	50,000 bbls.	$32 million	Under Constr.	Mid 1951	.....	.....	.....
Venezuela Gulf Refining Co.	Puerto la Cruz, Venezuela	Refinery	30,000 bbls.	.....	Under Constr.	July, 1950	.....	Lummus	Lummus
Venezuelan Pet. Co.	Puerto la Cruz, Venezuela	Refinery	35,000 bbls.	.....	Under Constr.	.....	.....	Snare	Snare
Yacimientos Petroliferos Fiscales	Buenos Aires, Argentina	New Refinery	25,000 bbls.	$54 million	Engineering	Late, 1950	.....	Kellogg	Kellogg
YPF	La Plata, Argentina	Crude Topping, Gaso Treating	50,000 bbls.	$2.8 million	Under Constr.	1949	.....	Houdry Process Cat. Constr.	Cat. Constr.
Yacimientos Petrolejeros Fiscales Bolivianos	Sucre, Bolivia	Crude Plant	3,000 bbls.	.....	Completed	.....	.....	Foster Wheeler	Foster Wheeler
YPF Bolivianos	Cochabamba, Bolivia	Topping & Reforming Units	5,000 bbls.	.....	.....	3rd Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Europe and Africa									
Anglo-American Oil Co.	Fawley, Eng.	Refinery Expansion	110,000 bbls.	$150 million	Under Constr.	Late 1952	.....	Foster Wheeler	Foster Wheeler
Anglo-Iranian Oil	Isle of Grain, Eng.	Cent. Refg. Unit	60,000 bbls.	$120 million	Planning	1952	Texaco (Lube Unit)	Lummus	Lummus
Anglo-Transvaal Consolidated Investment Co.	Vall River, Union of South Africa	Synthetic Gasoline and Diesel Oil Plant	.....	$60-60 million	Contracted	.....	.....	Hydrocarbon Research	.....
Azienda Generale Italiana Petroli	Rome, Italy	Add to Plant	24,000 bbls.	.....	Projected	Late 1951	.....	.....	.....
Azienda Generale Italiana Petroli	Palermo, Italy	Marine Fuel Plant	7,500 bbls.	.....	.....	.....	.....	.....	.....
Bataafsche Petroleum Mij.	Pernis, Holland	P. U. C. Plant	2,000 tons, yr.	.....	.....	Jan., 1950	.....	.....	.....
My. Bataafsche Pet.	Pernis, Holland	Expansion	50,000 bbls.	.....	Under Constr.	Mid 1952	.....	.....	.....
Cabot Carbon, Ltd. (Godfrey L. Cabot, Inc.)	Ellesmere Port Eng.	Carbon Black Plant	50,000 lbs. yr.	.....	Under Constr.	1950	.....	Simon-Carves, Ltd.	Simon-Carves, Ltd.
Caltex Pet. Maatschappij N. V.	Rotterdam, Holland	Complete Refinery	20,000 bbls.	$18 million	Under Constr.	Feb., 1950	.....	McKee, Badger, U.O.P.	McKee
Cie. de Raffinage Shell-Berre	Berre, France	Expansion	40,000 bbls.	.....	Under Constr.	Mid 1951	.....	.....	.....
Shell	Petit-Couronne	Teepol Plant	25,000 tons yr.	.....	.....	Mid., 1950	.....	.....	.....
Cie. de Raffinage Shell-Berre	Petit Couronne, France	Lube Unit	.....	.....	Planned	.....	.....	.....	.....
Cie de Raffinage Shell-Berre	Petit-Couronne (Rouen), France	Expansion	10,000 bbls.	.....	Under Constr.	Early 1950	.....	.....	.....
Cie. Francaise de Raffinage	Gonfreville, France	Lube Unit	2,500 bbls.	.....	Projected	1951	Texas	Kellogg-Lummus	.....
Cie. Francaise de Raffinage	Gonfreville, France	Distillation Unit	20,000 bbls.	.....	Under Constr.	1950	.....	Foster Wheeler	Foster Wheeler
Cie. Francaise de Raffinage	Provence, France	Topping Unit	20,000 bbls.	$11 million	Under Constr.	1950	.....	Foster Wheeler	Foster Wheeler
Cia. Espanola de Petroleos S. A. (C.E.P. S.A.)	Canary Islands, Spain	Furl. Ref. Sol. Dewax., Wax Fraction	5,000 bbls.	$4½ million	Under Constr.	Early 1950	Texaco, Standard, N. J.	Foster Wheeler	Foster Wheeler
Danish Government	Denmark	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....
Egyptian Government	Cairo, Egypt	Crude Plant	4,500 bbls.	.....	.....	.....	.....	Lummus	Lummus
Industrie Chimiche Italiane Petroli	Mantua, Italy	Crude	.....	.....	.....	.....	.....	.....	.....
Industria Nazionale Petroli e Trasformazione	Massa Carrara, Italy	Refinery	40,000 bbls.	.....	.....	Late 1951	.....	.....	.....
Industria Petrolifera e Chimica	Milan, Italy	Gasoline, Fuel Oil Plant	20,000 bbls.	.....	.....	.....	.....	Dr. Calogero Inglogio	.....
Imperial Chemical Industries, Ltd.	Wilton, Yorkshire, England	Petroleum Cracking Unit	.....	.....	Under Constr.	1950	.....	Kellogg	Kellogg
Koppartrans Co.	Goteborg, Swe.	Crd. Ther. Crk.	12,500 bbls.	.....	Under Constr.	Oct., 1949	.....	Lummus	Lummus
Stand.-Anenda Gen. Indro. Comb. (Stanic)	Leghorn, Italy	Add Capacity	28,700 bbls.	.....	.....	.....	.....	.....	.....
Ditto (Stanic)	Bari, Italy	Add Capacity	38,300 bbls.	.....	.....	.....	.....	.....	.....
L'Alliance Petrofina	Antwerp, Belg.	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....
Manchester Oil Refinery, Ltd.	Partington, England	Cat. Crk., Lube, Reforming	20,000 bbls.	.....	Projected	.....	.....	.....	.....
Monsanto Chemica Co.	Britain	Add Polystyrene	.....	.....	Design	Early 1950	.....	Staff	Staff
National Oil Refineries, Ltd.	Llandarcy, Wales	Crude and Reform	40,000 bbls.	$36 million	Designing	.....	.....	Badger	Badger
National Oil Refineries, Ltd.	Llandarcy, Wales	Furf. Ref. Sol. Dewax. Wax Fractn.	1,200 bbls.	.....	.....	.....	Texaco	Badger	Badger
National Oil Refineries, Ltd.	Llandarcy, Wales	SO_2 Solvent Extraction	3,000 bbls.	.....	Contracted	.....	.....	H. W. P.	.....
PechelBronn, S. A. E. M.	Merkweiller, France	Capacity Increase	1,450 bbls.	.....	Authorized	1950	.....	.....	.....
Petro Carbon, Ltd.	Partington, England	Cat. Cracker, Lube & Reform	30,000 bbls.	.....	.....	.....	.....	.....	.....
Petro Chem., Ltd.	Partington, Avonmouth, Eng.	Petro Chemicals	2,000 bbls.	$16 million	Under Constr.	1949	Petro-Carbon Phillips	Petro-Carbon H. W. P.	Petro-Carbon H. W. P.
Philblack, Ltd.		Carbon Blk. Plt.	137,000 bbls.	$5 million	Contracted	1950	.....	H. W. P.	H. W. P.
Porto Marghera Refg.	Venice, Italy	Enlarge Crd. Refinery	20,000 bbls.	.....	Contracted Under Constr.	July, 1951	.....	.....	.....
Raf. de Pet. de Escom., S.A.	Cartagena, Spain	Therm. Crk., Reform., Gas Plt.	.....	$2 million	Under Constr.	Late 1949	.....	Barnes	Barnes
Raffinerie Belge de Petroles S.A.	Antwerp, Belgium	Refinery	13,000 bbls.	$7.8 million	Reconstr.	Early 1950	.....	U.O.P., McKee	McKee
Raffineries de Petrole de la Gironde	Bec Ambes, France	Consolidate Refineries	7,100 bbls.	$9.4 million	.....	.....	.....	.....	.....
Raffineries Francaises de Petrole de l'Atlantique	St. Nazaire, France								

• CONTINUED ON NEXT PAGE

REFINERY AND OTHER PLANT CONSTRUCTION (Continued)

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Raffineria di Napoli, S P A	Naples, Italy	Visbreaker	.....	.....	.....	Early, 1950	.....	Staff	Staff
Raffineria di Napoli, S. P. A.	Naples, Italy	Topping Unit	15,000 bbls.	.....	Under Constr.	Late 1949	.....	Staff	Staff
Raffineria di Napoli	Naples, Italy	Solvent Treating	1,000 bbls.	.....	Under Constr.	Dec., 1949	Texaco	Staff	Staff
Raffineria di Napoli	Naples, Italy	Reformer	5,000 bbls.	.....	Under Constr.	Early 1950	.....	Staff	Staff
Raffinerie Siciliane Olii Minerali, S.A.	Augusta, Sicily	Crude Refinery	10,000 bbls.	.....	Designing	Early 1950	U.O.P.	U.O.P., Delta	S. T. I. I.
Scottish Oils, Ltd.	Grangemouth, Scotland	Crude	28,000 bbls.	$28 million	Designing	.....	.....	Kellogg	Kellogg
Scottish Oils, Ltd.	Grangemouth,	Cat. Crk.	5,000 bbls.		Planned	.....	.....	.....	.....
*Shell Chemical Corp	Stanlow, Ches-Cheshire, Eng.	Refinery	2.5 million Tons/year 24,000 tons Solvents/year	$16 million	Under Constr.	.....	.....	.....	.....
Shell Chemical Mfg. Co., Ltd.	Thornton, Eng.	Teepol Plant Extension	75,000 tons per Year	.....	Under Constr.	Jan., 1950	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Stanlow, Eng.	Comprehensive Refining	50,000 bbls.	.....	Under Constr.	Early, 1952	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Shell Haven, England	Comprehensive Refinery	65,000 bbls.	.....	Under Constr.	Mid 1951	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Hamburg-Harburg, Germany	Refinery	8,950 bbls.	.....	Under Constr.	Late 1949	.....	.....	.....
Société Generale des Huiles de Petrole	L'Avera, France	LPG Units	25,000 bbls.	.....	Under Constr.	Mid 1950	Kellogg	Kellogg	Staff
Société Generale	Dunkirk, France	Crude Reform.	33,000 bbls.	.....	Under Constr.	Mid 1951	Lummus, Kellogg	Lummus, Kellogg	Lummus, Kellogg
Société Generale	Dunkirk, France	Furf. Ref. Sol. Dewax., Wax Fractn.	2,400 bbls.	.....	Designing	Mid 1951	Texaco	Lummus	Lummus
Societe Industriel Belgique de Petrole	Antwerp, Belgium	Crude, Cracking Reforming	30,000 bbls.	.....	Designing	Mid 1951	.....	.....	.....
Societa per Azioni Raffineria Padana Olii Minerali	San Martino di Trecate, Italy	Refinery	13,000 bbls.	.....	Proposed	.....	.....	.....	.....
Socony-Vacuum Francaise	Notre Dame de Gravenchon, France	Contact Plant	.....	.....	Completed	.....	.....	Staff	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon,	MEK Unit	1,000 bbls.	.....	Design	Mid., 1950	Texaco	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon,	Propane Deasphalting	1,100 bbls.	.....	Design	Mid 1950	Jusk	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon,	Grease and Compounding	.....	.....	Under Constr.	Mid 1950	.....	Staff	Staff
Standard Francaise des Pétroles	Port Jerome, France	Dewaxing Plant	1,000 bbls.	.....	Planned	.....	.....	.....	.....
Standard Francaise des Pétroles	Port Jerome, France	Deasphalting Plant	2,000 bbls.	.....	Planned	.....	.....	.....	.....
Standard Oil Co., (N.J.)	Belgium	Dist. Crack.	33,000 bbls.	.....	Planned	Early 1952	.....	.....	.....
Trent Oil Prod. Development Co.	North Shields, England	Crude Plant	11,500 bbls.	$4 to $8 million	Plans approved	.....	.....	.....	.....
Union Petrol Refinery, Ltd.	Johannesburg, Union of South Africa	New Refinery	.....	$30 million	Projected	.....	.....	.....	.....
Near East									
Anglo-Iranian Oil	Abadan, Iran	Gas Plant	25,000 mcf	$2 million	Under Constr.	1950	.....	Badger	Badger
Anglo-Iranian Oil	Abadan, Iran	Cat. Cracker	30,000 bbls.	.....	Under Constr.	1951	.....	Foster Wheeler	Foster Wheeler
Anglo-Iranian Oil	Abadan, Iran	Solvent Dewax.	400 bbls.	.....	Under Constr.	.....	Texaco	Badger	Badger
Arabian American Oil Co.	Abqaiq, Saudi Arabia	Crude Oil Stabiliser	300,000 bbls.	$4.8 million	Under Constr.	Summer, 1950	.....	Staff and Fluor	Staff and Fluor
Arabian American	Abqaiq, Saudi Arabia	Steam Power Plant, etc.	20,000 kw	$9.4 million	Completed	.....	.....	Staff and Fluor	Staff and Fluor
Arabian American	Ras Tanura, Saudi Arabia	Add Power Generating Unit	10,000 kw	$1.75 million	Completed	.....	.....	Staff and Fluor	Staff and Fluor
Arabian American	Ras Tanura, S.A.	Ref. Adds.	.....	.....	Under Constr.	1949	.....	Bechtel	Bechtel
*Arabian American Oil Co.	Ras Tanura, Saudi Arabia	Asphalt Plant	500 bbls.	$1,250	Plans Approved	1950	.....	Staff, Bechtel	Staff
Bahrein Pet. Co., Ltd.	Bahrein Island	Expansion Program	.....	$8.3 million	Under Constr.	Oct., 1949	.....	U.O.P., Bechtel	International, Bechtel, Inc.
Bahrein Pet. Co., Ltd.	Bahrein Island	Crd. Still Util.	55,000 bbls.	$9.1 million	Postponed	Aug., 1950	.....	Lummus, Bechtel	.....
Consolidated Ref., Ltd.	Haifa, Palestine	Crude Plant	80,000 bbls.	.....	Planned	Late, 1951	.....	Badger	Badger
Consolidated Ref., Ltd.	Haifa, Palestine	Gen. Fabilities	.....	.....	Under Design	.....	.....	Badger	.....
Consolidated Ref., Ltd.	Haifa, Palestine	Lube Plant	2,500 bbls.	.....	Designing	.....	Texaco, Jusk	Lummus, Kellogg	Lummus, Kellogg
Kuwait Oil Co	Fahahil Kuwait	Topping Unit	20,000 bbls.	$2 million	Completed	.....	.....	Badger	Badger
Far East									
Bataafsche Pet Mij (Shell)	Balikpapan, Borneo, East Indies	Expansion	42,000 bbls.	.....	Under Constr.	Mid., 1952	.....	.....	.....
*Bataafsche Pet. Mij.	Pladjol, Sumatra	Rehab. to Comprehensive Refg.	70,000 bbls.	.....	Under Constr.	Mid., 1951	.....	.....	.....
Burmah Oil Co.	Syriam, Burma	Furf., Sol. Dewax., Wax Mfg.	1,000 bbls.	$600,000	Designing	.....	Texaco	Badger	.....
Burmah Oil Co.	Syriam, Burma	Thermafor Clay Revivification	66 tons	$150,000	Design	1949	Max Miller, Socony-Vacuum	Max Miller	.....
Oceania									
Australian Shell Oil Co.	Clyde, New S. W., Australia	Luboil Refining	250 bbls.	.....	Under Constr.	.....	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	New Refinery	.....	$4.8 million	Under Constr.	Late, 1951	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	Bitumen and Luboil Plant	.....	.....	Projected	.....	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	Asphalt, Lube Solvent Extraction Plants	.....	.....	.....	.....	.....	.....	.....

NOTE: Badger—E. B. Badger and Sons. Barnes—W. M. Barnes & Co. Bechtel—Bechtel Corp. Bellows—W. S. Bellows Co. Blaw-Knox—Blaw-Knox Construction Co. Bowden—W. H. Bowden. Braun—C. F. Braun Co. Brown Eng.—Brown Engineering Co. Brown & Root—Brown & Root Construction Co. Cat. Constr.—Catalytic Construction Co. Chemico—Chemical Construction Co. C.B.&.I.—Chicago Bridge & Iron Works Co. Clarke—Clarke Construction Co. Constr. Service—Construction Service Co. Delta—Delta Engineering Corp. Dresser—Dresser Engineering Corp. E. & A.—Ehrhart & Arthur, Inc. Fish Eng.—Fish Engineering Corp. Fluor—Fluor Corp. Foster Wheeler—Foster Wheeler Corp. Gasc. Plant—Gasoline Plant Construction Co. General American—General American Transportation Co. Girdler—The Girdler Corp. Graff—Graff Engineering Co. Hammond—Hammond Iron Works Co. Houdry—Houdry Corp. Hudson—Hudson Engineering Corp. H. W. P.—Head Wrightson Processes, Ltd. Hydro Res.—Hydrocarbon Research, Inc. Ind. Eng.—Industrial Engineers, Inc. J. & L. Constr.—Construction Division, Jones & Laughlin Supply Co. Kellogg—M. W. Kellogg Co. Koch—Koch Engineering Co. Koppers—Koppers Co., Inc. Knowles—Morris Knowles & Co. Leonard—Leonard Construction Co. Lummus—The Lummus Co. Mason—Mason Brothers Construction Co. McKee—Arthur G. McKee Co. Max Miller—Max B. Miller & Co. Parsons—The Ralph M. Parsons Co. Pet. Eng.—Petroleum Engineering, Inc. Petro—Petroleum Rectifying Co. Pritchard—J. F. Pritchard Co. Process Eng.—Process Engineers, Inc. Process Constr.—Process Construction Co. Ref. Eng.—Refinery Engineering Co. Ref. Maint.—Refinery Maintenance Co., Inc. Rust Eng.—Rust Engineering Co. Schneider—Schneider & Cie. Snare—Frederick Snare Corp. Sollitt—Summer S. Sollitt Co. S.O.D.—Standard Oil Development Co. State Eng.—State Engineering Co. Stearns-Roger—Stearns-Roger Manufacturing Co. Stone & Webster—Stone & Webster Construction Co. Tellepsen—Tellepsen Construction Co. Texaco—Texaco Development Co. U.O.P.—Universal Oil Products Co. Walco—Walco Engineering. Wohfeld—Wohfeld Construction Co. Equally owned California Texas Corp. and Socony-Vacuum Oil Co., Inc.

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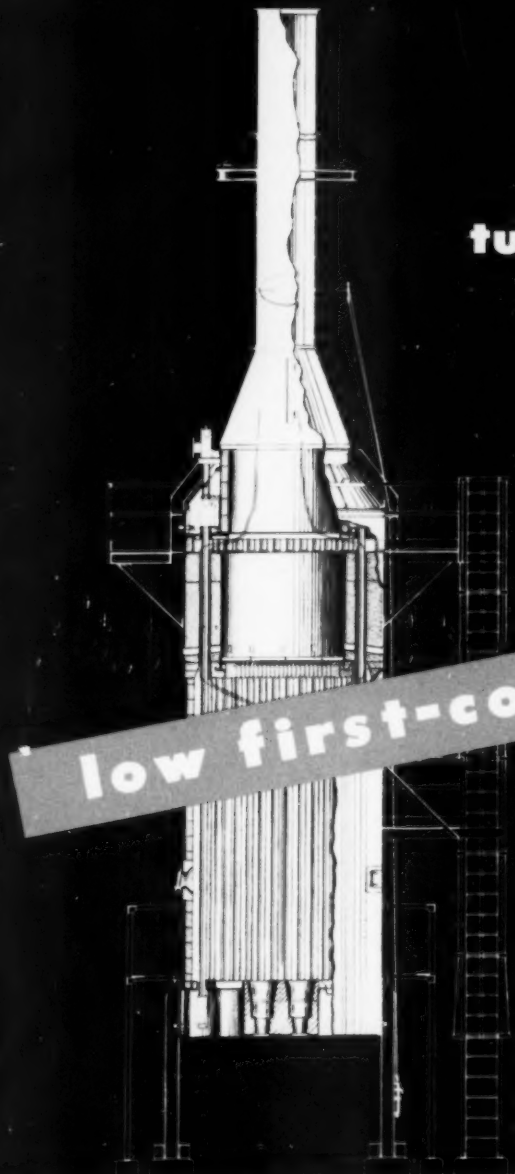

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PETROLEUM
REFINER
OCTOBER, 1949

Use of Aluminum In the Petroleum Industry

FRED L. PLUMMER
Director of Engineering, Hammond Iron Works, Warren, Pa.

***"THE COST OF** corrosion in the petroleum industry goes far beyond the cost for replacement, repair and maintenance," F. A. Rohrman[1] writes. "It is difficult to say what extra charge for gasoline or fuel oil is made because of corrosion, but there is good reason to believe that it is close to 10 percent. For example, an average sour crude will destroy an unprotected steel tank in from 3 to 10 years."*

E. Q. Camp, before the API in 1947, said "roofs of tanks in sour crude service have a life varying from about 5.3 to 11.6 years, with 8.7 years the average. Tank roofs in sour-distillate service have a life from 3.8 to 14.3 years with an average of 7.9 years." Among the methods for increasing service life of such tanks Camp lists: a) use of heavier steel construction, b) use of aluminum, c) use of protective coatings such as galvanizing, gunite, paints and plastics or d) caustic washing.

Use of aluminum in attacking high costs resulting from corrosion as well as its other advantages (lightness in weight, etc.) are discussed here.

IMPURITIES in crude oil create severe corrosion problems in the production, refining and distribution of finished products. These impurities include calcium and magnesium chlorides, hydrochloric acid, the naphthenic acids and especially the various sulfur compounds including hydrogen sulfide.

"Sour" crude oils, now being widely produced, contain a relatively high percent of sulfur and sulfur compounds. The rapid corrosion of the roofs and upper shell courses of steel tanks used for the storage of such high-sulfur crude oils, is due to the action of hydrogen sulfide, oxygen and water. In addition to the serious problem of corrosion, the oxidation of sulfur compounds in the presence of iron compounds produces heat which creates an ignition hazard through spontaneous combustion.

Since aluminum and its alloys are highly resistant to the corrosive action of hydrogen sulfide at temperatures below 250° F., their use for the roof and possibly for the upper shell courses of sour crude oil storage tanks will eliminate this ignition hazard and insure a long service life for these portions of the tank. Because of the relatively high cost and low strength of welded aluminum alloy tank shells, it is more economical to use steel for all but the upper one or two courses of such tank shells. The lower courses are much less subject to corrosive attack by sulfur compounds. The bottom and the first course of the shell of such tanks are often subject to corrosive attack by brines and impurities which settle out of the crude petroleum. Since aluminum alloys may not be much more resistant than steel to the corrosive action of brine, it is also more economical to use steel for the tank bottom. Thus a combination tank having bottom and shell of steel and roof (with possibly the upper part of the shell) of an aluminum alloy offers a possible economic solution of the problem of storing petroleum products with high sulfur content.

In 1929 Stanley Gill discussed[2] the use of aluminum alloys in the oil industry and described an early test of bolted aluminum tanks conducted by Gulf Producing Company in Texas. The U. S. Bureau of Mines issued two reports[4] in 1931 describing tests made on the use of aluminum for oil lease tanks, under the joint sponsorship of the Bureau, the State of Oklahoma, Aluminum Company of America, Gulf Oil Corporation, and Parkersburg Rig and Reel Company.

Properties and Uses of Aluminum Alloys

Aluminum and its many alloys constitute a versatile group of metallic

Figure 1. Truck Trailer Tank Constructed of 99.6 percent Aluminum.

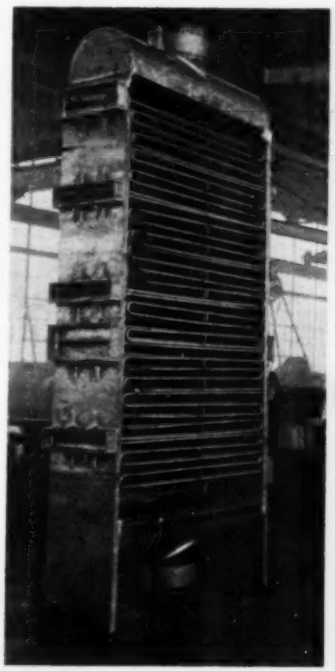


Figure 2. Internal View of S-Type Tubular Exchanger with 2-inch Thick Tube Sheets Alloy 35. (Both photos this page courtesy The Colonial Iron Works Company.)

materials having a wide range of desirable physical and chemical properties. Because of these properties aluminum alloys have been used successfully and economically for drilling rigs, ladles, piping, tanks, process vessels, heat exchangers, trucks, tank cars, electrical conduits, paint and many other special applications.

Weight, Thermal and Electrical Properties

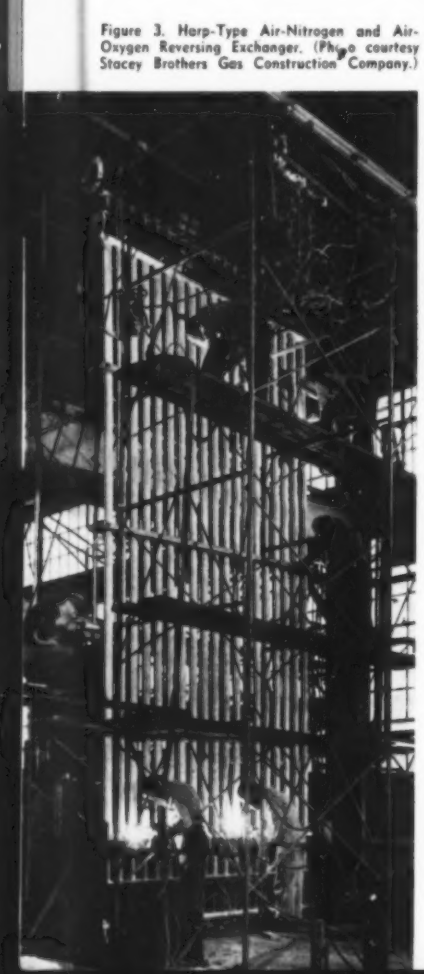
Aluminum alloys, which weigh about one-third as much as steel, offer great advantage where the cost of power becomes significant. Figure 1 shows a truck trailer tank constructed of 99.6 percent aluminum, fabricated by use of the argon-shielded tungsten-electrode arc welding process. Weight also is an important factor when considering equipment for use in development of areas which must be supplied by air or by land over undeveloped or swampy country without roads. In such cases the use of aluminum alloys may result in substantial economies and at the same time materially speed up the completion of the work. For storage tanks lighter roofs result in some savings in roof supports. Freight costs are lower. The lighter pieces must be handled more carefully in the fabricating shop and during field assembly and therefore handling costs are about the same as for corresponding steel pieces.

The thermal conductivity and electrical conductivity of aluminum alloys are high and as a consequence much aluminum is used for food processing equipment, parts of internal combustion engines, heat exchangers, etc. Figure 2 shows an interior view of an S-type tubular heat exchanger (constructed of 3S aluminum alloy, tube sheets 2 inches thick) designed for use in the production of oxygen. These properties are usually of little significance in connection with storage tanks except as they influence fabrication processes such as welding.

The coefficient of thermal expansion of most aluminum alloys is approximately two times that of steel. Because of this, distortion effects resulting from the heat of welding, may be more severe in aluminum alloy than in steel plate vessels. This difference in expansion coefficients must be carefully considered when aluminum and steel or other metals are used in composite structures. With proper design such composite structures have been found to perform in a satisfactory manner.

Aluminum is a nonsparking metal, an important property when considering storage or process tanks for explosives and for many petroleum and chemical products.

Figure 3. Herp-Type Air-Nitrogen and Air-Oxygen Reversing Exchanger. (Photo courtesy Stacey Brothers Gas Construction Company.)



Working and Assembling

It is relatively easy to shape and work aluminum by all of the usual shop fabricating processes with the exception of flame cutting. Aluminum alloys can be cut with a burning torch; however, it is usually necessary to make the cut some distance from the desired finished edge and complete the cut by some other method.

Vessels constructed of aluminum alloy plates can be assembled by bolting, riveting or welding. The physical properties of some of the aluminum alloys are improved by heat treatment and cold working. If plates of these alloys are assembled by welding the improvement in properties over the annealed condition may be lost due to the heat of welding. Aluminum alloys can be fusion welded by most of the commonly used commercial methods including gas, metal arc, carbon arc, atomic hydrogen and the now popular inert-gas-shielded tungsten-electrode arc. Electric-resistance welding in its various forms can also be used. In the construction of field-erected storage and process vessels of aluminum, gas welding has generally been used. It seems probable that welding with inert-gas-shielded tungsten-electrodes may be generally used, thereby eliminating the necessity of using a welding flux and permitting welding in any position. The newly developed "aircomatic" process, in which a metal electrode is fed automatically as the arc end burns off in a shielding atmosphere of argon, gives promise of becoming a satisfactory and economical method of making welded joints in aluminum alloy plates or sections in any welding position and without the use of a welding flux. Aluminum alloys 2S, 3S, 61S and 52S are most readily fusion welded.

Mechanical Strength

The moduli of elasticity of the various aluminum alloys are each equal to slightly more than one-third that of steel. Thus for a given unit stress, elastic deformations, including the deflection of members subjected to bending moments, will be correspondingly greater. For typical cone roof storage and process vessels deflection of the roof and stretch of the vessel walls do not result in critical effects. Therefore, in general, this lower modulus of elasticity does not create serious design problems. In certain cases and especially in composite structures, it may become necessary to consider the larger deformations which result from the use of aluminum alloys. Since the critical strength of slender compression members is a function of the modulus of elasticity of the material rather than its crushing strength, it is more difficult to select economical sections for long columns such as those required for large storage tanks if a material having a low modulus of elasticity is used.

Similarly it is necessary to give careful consideration to the design of aluminum vessels which operate under external pressures or the equivalent internal vacuums, since the shells of such vessels must act as compression rings and the collapsing strength may also depend upon the modulus of elasticity of the material. In the construction of such vessels it is essential that out-of-roundness be held to a minimum. F. V. Hartman[5] has published curves which may be used as a guide for the design of aluminum alloy vessels subjected to service forces tending to cause collapse. E. G. Kort[6] has also published valuable suggestions for designing and manufacturing aluminum equipment.

The mechanical strength properties of the various aluminum alloys cover a wide range with some of the alloys having ultimate tensile strength equal to or even greater than 80,000 psi. For most of the high-strength alloys (not including 17S-T6 and 24S-T6) the yield strength as determined by the "0.2 percent offset" method will equal more than 85 percent of the ultimate tensile strength. The elongation of the high-strength alloys is relatively low. Alloy 3S is a general-purpose wrought-aluminum alloy that has been used for many relatively small, field-erected storage tanks. Alloy 3S-F (as fabricated) or 3S-O (annealed) will have an ultimate minimum tensile strength of at least 14,000 psi., a yield strength of perhaps 5300 psi. and a high percent elongation. This same material when strain hardened may have a tensile strength of 29,000 psi. and a yield strength of 26,000 psi., with elongation of 10 percent or less in 2 inches. When assembled by welding it is safe to use the values listed above for the annealed condition.

Alloy 61S-T6, which is recommended for larger welded tanks, has an ultimate tensile strength of 45,000 psi. and yield strength of 40,000 psi. before welding. Plates of different thicknesses assembled by welding will have the following approximate strength values:

Plate Thickness, Inches	Tensile Strength, Psi	Yield Strength Psi
½	32,000	22,000
⅛	30,000	20,000
¾	28,000	18,000

For storage and process vessels constructed of steel plates, various standard codes permit a basic design stress in tension equal to the minimum ultimate tensile strength of the plate material divided by a nominal factor of safety, F. The following list gives typical values for F.

Code		F
API 12-C	All-Welded Oil Storage Tanks	2.62
AWWA	Elevated Steel Water Tanks, Standpipes and Reservoirs	3.67
API-ASME	Unfired Pressure Vessels	4.00
ASME	Unfired Pressure Vessels (U68-U69)	5.00

Using these same factors the corresponding basic design stress for welded tanks constructed of aluminum alloy 3S would vary from about 5300 to 2800 psi., and for those constructed of alloy 61S or equal from about 12,000 to 5600 psi., depending to some extent upon plate thickness. As in the case of welded joints in vessels made of steel, a joint efficiency factor should be used with these design stress values. For vessels assembled by riveting or bolting, the design stresses may be based on yield strengths and ultimate strengths of the various alloys for the condition indicated by the proper temper designation.

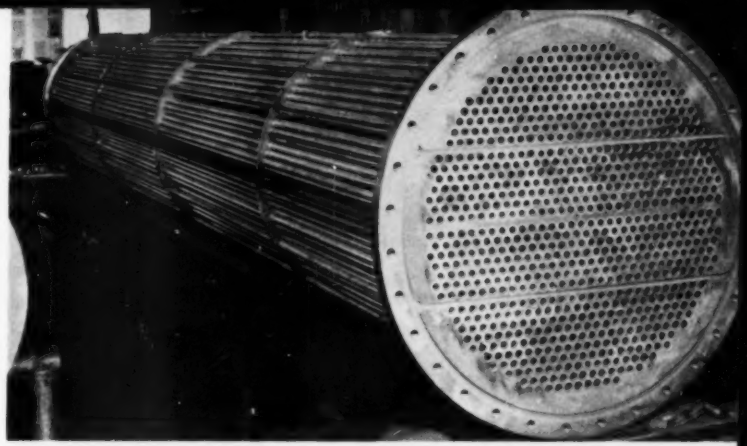


Figure 4. Oil-to-Oil Heat Exchanger Bundle of Aluminum 3S-H14 Alloy Tubes. (Photo courtesy Aluminum Company of America.)

The 1947 Addenda to the Material Specifications of the ASME Boiler Construction Code under Specification SB-178 which is identical with ASTM Specification B 178-47T, lists five types of alloys—A3 (99.6 percent min. aluminum), A2 (2S), M1 (3S), GR1 (52S) and GS21 (61S)—and gives chemical and physical properties of each. Table U3 of the ASME Unfired Pressure Vessel Code (revised in 1948 Addenda) gives allowable design stresses for alloys A2 (2S) and M1 (3S) for different temperature ranges up to a maximum of 400° F. Pressure vessels constructed of aluminum alloys may be stamped with the code symbol if design and construction meet the requirements of Case No. 994 as issued in 1949.

Committee 12 of API is considering the adoption of rules covering the construction of storage vessels of aluminum designed to operate at atmospheric temperatures and pressure.

Properties at High and Low Temperature

Pure aluminum melts at 1220° F. The various aluminum alloys generally melt at slightly lower temperatures in this same general range. The following values of a factor "K" have been suggested for determining the proper design stress for welded tanks subjected to elevated temperatures:

Temperature, °F.	Factor K	Temperature, °F.	Factor K
100	1.00	400	0.525
150	0.90	500	0.37
200	0.83	600	0.25
300	0.693	700	0.18

Design stress values such as those noted above are used for temperatures up to 100° F. For higher temperature ranges multiply these stress values by the proper value of K. The codes for pressure vessels do not permit aluminum vessels to be worked at temperatures greater than 400° F.

Aluminum alloys do not become brittle at low temperatures. Test reports[7] have been published for values of ultimate tensile strength, percent elongation and Charpy impact energy for aluminum welds made in 3S plates varying in thickness from ⅜ to 2 inches and tested at room temperature and at —320° F. Charpy impact tests were reported for parent metal, all weld metal and for metal from the heat-affected zone. Tensile strength was found to be appreciably higher (as much as twice for all weld metal), and elongation and impact values approximately unchanged at the subzero temperature. Kort[6] lists the following typical tensile properties for alloy M1 (3S):

Temperature, °F.	Tensile Strength, psi	Yield Strength psi	Elongation percent
75	16,000	6,000	40
0	17,000	6,000	41
—112	19,500	7,000	42
—320	33,000	8,500	46

The values for elongation were determined from round specimens having a gauge length equal to four times the diameter. Because of this property, aluminum alloys have recently been specified for use in the construction of oxygen-generating plants, where they are subjected to service stresses at very low temperatures. Figure 3 shows a shop fabricated unit of a harp-type air-nitrogen air-oxygen reversing exchanger consisting of seven banks of such units. Each unit consists of 19 columns of concentric aluminum tubes varying in diameter from ¾ to 3½

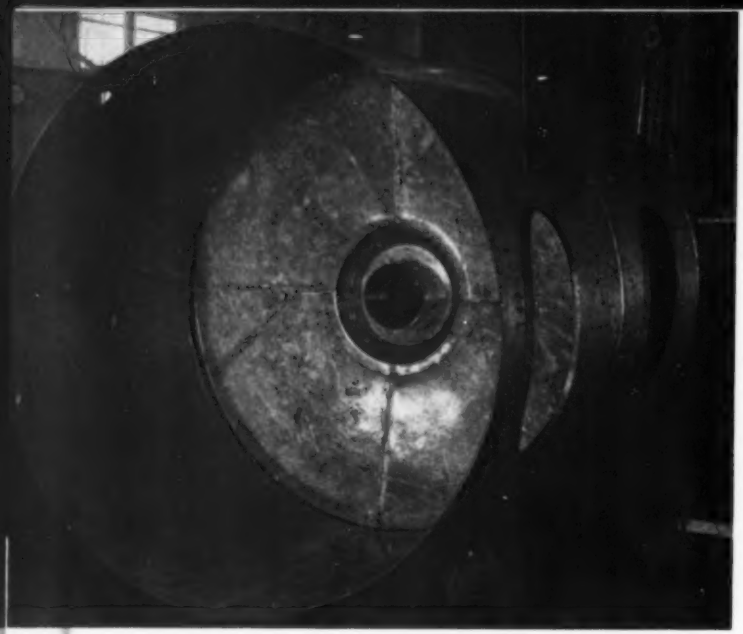


Figure 5. Dorr Tray Thickener Built of Aluminum Alloys. (Photo courtesy Hammond Iron Works.)

inches and manifolded into 3-," 6-, 8- and 10-inch diameter headers.

Fire Resistance

Because of the relatively low melting point of aluminum alloys, fire departments of municipalities in the Los Angeles area and elsewhere have questioned whether these materials should be used for the construction of all or parts of oil storage tanks. During March, 1948, the Inglewood, Calif., fire department arranged for a fire test in a small open-top tank constructed of aluminum alloy 61S for shell and R 350H for bottom. In this test the tank shell at and below the liquid level did not fail; however, the shell above the liquid level burned away to within about ½ inch of the oil level on the downwind side and to within about 6 inches of the oil level on the windward side. Thus, while there was no indication of danger of release of the liquid by bursting of the tank, there was less safety against "boil over" of those products subject to this effect. Such "boil over" waves may result if a mass of hot oil comes into contact with water which might have collected in the bottom of a tank, changing some of this water into steam and creating a volume of froth 1700 times greater than that of the water so transformed. It has been reported by the API that when certain oils burn, heat is carried down into the oil for some distance to a "heat-wave front" which forms a sharply defined division between hot and cold oil.

The report of the Inglewood tests stated that "aluminum alloy tankage is in no way comparable with steel in fire resistance" and suggested that its use be limited to oils having a high flash point and those in which "heat waves and slop-over or serious frothing is not to be expected," and to relatively small tanks. The report recommends that aluminum alloy tanks, if used for crude oil service, be located "where early boil overs are not likely to jeopardize important valves," and that they be widely spaced with individual dikes.

The general results of this fire test have been verified by many fire tests made on truck tanks for gasoline haulage. In each case the aluminum alloy tanks have remained intact below the liquid level. Above the liquid level, the metal was melted if the fire was of long duration.

Corrosion Resistance

This is the most important single property of the aluminum alloys in determining their economical use under a great variety of service conditions. A thin, firmly adherent coat of oxide is formed over the surface of aluminum, preventing further action of many chemicals. Resistance to corrosion is a relative term. It will, of course, vary for different conditions of exposure. Aluminum alloys have been used effectively for storing concentrated nitric and acetic acids, hydrogen peroxide and gaseous compounds of sulfur. Since the aluminum salts have no harmful action on the human system it is widely used in the processing of foods and beverages. The compounds formed by superficial attack of many chemicals are colorless. Hence, aluminum is used for the processing of gums and resins used in clear varnishes and lacquers, and in the manufacture of rayon where compounds of sulfur are generally used.

Aluminum, which is a highly electronegative metal, owes its corrosion resistance to an oxide film. If this oxide film is continuously destroyed, the aluminum will be deprived of its corrosion resistance. Thus, aluminum and aluminum alloys are generally not resistant to strong alkalies, strong mineral acids and chlorides which create conditions which result in the destruction of this oxide film. Similarly, aluminum might not be satisfactory in any service where the oxide film is constantly removed by erosion or abrasion.

Galvanic Corrosion

Aluminum is anodic to many other metals, and will suffer electrolytic attack if an electrolyte is present and the aluminum is in contact with a heavy metal such as copper, brass, tin, lead, or steel. A solution containing salts of such heavy metals can result in a similar condition if permitted to come in contact with aluminum. If steel and aluminum are used in the same structure it is necessary to avoid direct contact of the two metals in order to be sure that galvanic action is prevented. In neutral or slightly acid solutions zinc is anodic to aluminum and is sometimes used to protect aluminum from corrosive attack. Pieces of the metal are mechanically attached to the aluminum at points below the surface of the liquid. Mears and Fahrney[8] have published a complete discussion of the protection of aluminum equipment by means of zinc attachments.

Shop Fabricated Storage and Process Vessels

Many relatively small tanks have been constructed of aluminum alloys for the storage of chemicals such as acetic acid, hydrogen peroxide, ammonia, formaldehyde, glycerin, hydrocyanic acid and some of the fatty acids such as stearic and oleic. Aluminum process vessels also have been used in the preparation or processing of foods, dairy products, textiles, soaps, cosmetics, paints, explosives and brewery products.

Figure 4 shows the fabrication of an oil to oil heat exchanger bundle with aluminum 3S-H 14 alloy tubes being fabricated in a shop.

H. R. Toll[9] has described the construction of several aluminum storage tanks constructed of 3S aluminum al-

loy in the "as-rolled" condition and used for the storage of resin in powder form. Each tank consits of a cylindrical shell 11 feet 6 inches in diameter with flat top cover and steep cone bottom, the over-all length being 39 feet 6 inches.

Figure 5 shows part of the shell and one tray of a tray thickener 6 feet in diameter and 17 feet long, being fabricated. The tank as completed has three trays and a launder, and is arranged for a gear motor with chain drive and a 4-inch shaft with scraper blades. This thickener is subjected to severe service conditions, including contact with a hot solution of aluminum oxide together with sulfuric acid. The aluminum plates are given a coating of "nitrocoat" in order to successfully meet these service conditions.

Figure 6 shows a construction view, before installation of aluminum shrouding, of the truck trailer tank (shown completed in Figure 1). Note access openings to the four compartments of the tank and support details. This tank is used for the handling of hydrogen peroxide.

Figures 6 to 10 inclusive show aluminum tanks that are being fabricated. Figure 7 is a general view of part of the shop showing the fabrication of nine aluminum alloy 3S tanks used for the storage of fatty acids, and equipped with heating coils. The tanks are 11 feet, 6 inches in diameter and 14 feet high with flat bottoms and

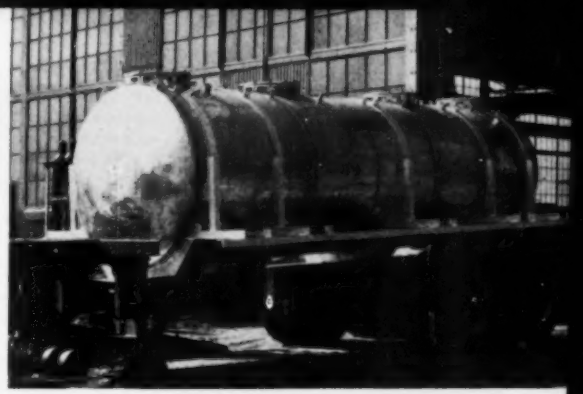


Figure 6. Aluminum Truck Trailer Tank before Installation of Shrouding.

low cone roofs. They were constructed of 3S aluminum alloy plates joined by argon-shielded tungsten-electrode welding.

Figure 8 shows an aluminum tower 4 feet in diameter and 24 feet high made of 3/8-inch thick plate with a minimum 99.6 percent aluminum. For many services this commercially pure aluminum has superior corrosion resistance.

One of two identical storage tanks for acetic acid is shown in Figure 9 ready for shipment. Constructed of 3S aluminum alloy plates, 3/8 inch thick, and 36 feet long and 10 feet in diameter, the tank was designed and fabricated to meet the requirements of paragraph U69 of the ASME Unfired Pressure Vessel Code.

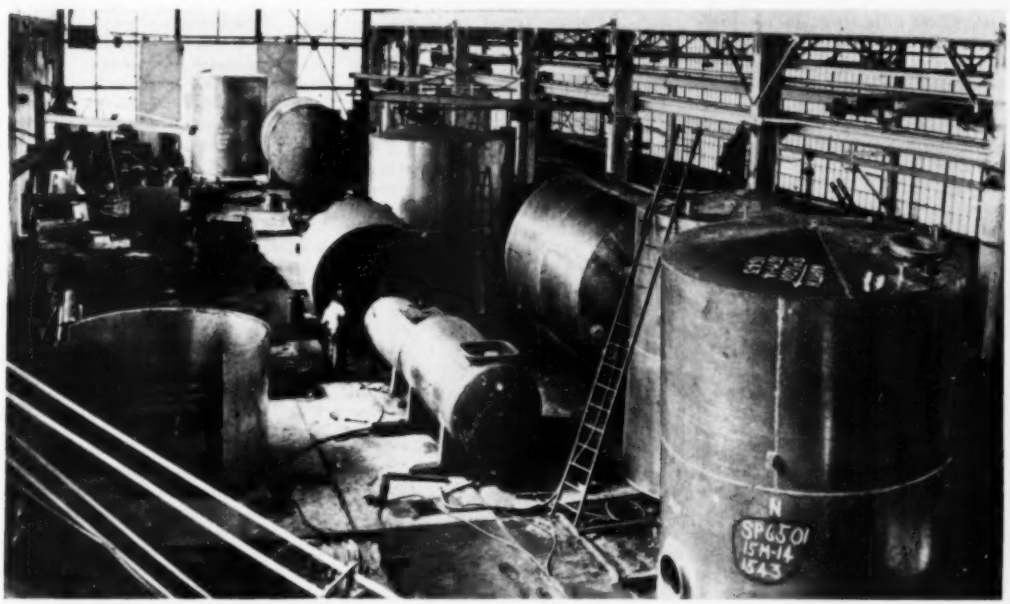
Figure 10 shows a water storage tank, with 1½-inch I.P.S. aluminum coil, constructed of 3S aluminum alloy. The tank is 12 feet in diameter by 14 feet high with flat bottom and cone roof, assembled by welding.

In many refinery vessels, internal components such as bubble trays and caps built of aluminum have been giving satisfactory service for long periods.

Aluminum Piping and Pipelines

C. B. McLaughlin[10] in an excellent discussion of aluminum piping emphasizes the following as having special advantages in connection with piping: "high strength, light weight, good thermal conductivity, resistance to corrosion, passivity when in contact with numerous corrodents, and absence of sparking characteristics." Alumi-

Figure 7. Aluminum Tanks for Fatty Acid Storage, Colonial Iron Works Fabricating Shop. (Photos on this page courtesy The Colonial Iron Works.)



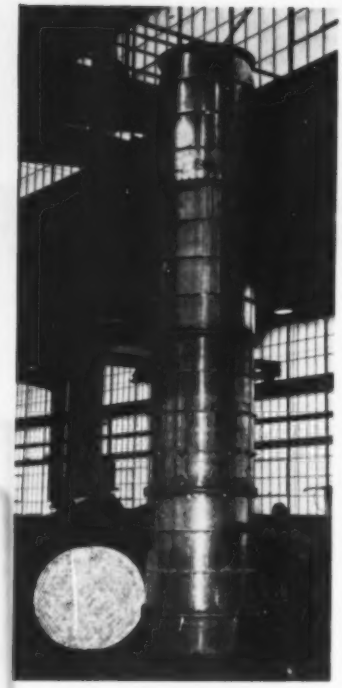


Figure 8. Aluminum Tower.

num pipe and fittings are radily available and the cost is relatively low as compared with other corrosion resisting materials. (Again note that the products of mild corrosion of aluminum are both colorless and nontoxic, both of these factors being important for certain applications.) Aluminum piping cannot be used for high-temperature service (applications involving temperatures of 200° F. or higher should be given careful design study); however, it can be used for very low-temperature service. The resistance of aluminum to the corrosive attack of hydrogen sulfide and other sulfur compounds found in sour crude oils is probably its most important property when being considered for use as piping for transfer of oil and gas. Large quantities of liquid oxygen are used in the synthesis of gasoline from natural gas. This requires operating temperatures as low as —300° F. Aluminum piping gives satisfactory service at such temperatures and has been used at the well head, in refineries and in distribution of petroleum products.

In large part due to the acute shortage of steel pipe during 1947, a number of experimental installations of aluminum pipe lines were considered. Experiments and experience indicated that aluminum alloys might be quite satisfactory for this service, both with regard to soil corrosion and corrosion due to the product carried inside the pipe. In damp alkaline soils, corrosion of aluminum should be more severe than for steel and it would be necessary to wrap such pipe.

Aluminum alloys 61S and 63S which are heat-treatable magnesium silicide alloys are usually recommended for oil pipe lines. The greater coefficient of thermal expansion must be considered in providing for temperature changes of aluminum piping. The cost of an aluminum pipe line may equal from 1.40 to 1.50 times that of a steel pipe line of equal size.

Figure 11 shows the field welding of a 6-inch diameter aluminum alloy pipe line being laid at Magnolia, Ark. during 1948. The 40-foot lengths of alloy 63S-T5 were joined by the argon-shielded tungsten-electrode arc welding process illustrated in the picture, to form the line approximately 5½ miles long. This installation has been described by M. R. Rivenburgh.[11]

Galvanic Action Between Steel and Aluminum

In a tank constructed of a combination of steel and aluminum alloy plates and shapes it is essential that direct contact of the two metals be avoided at points where they are joined, in order to eliminate the possibility of galvanic corrosion of the aluminum alloy. If possible the two metals should be joined so as to avoid flat surfaces or pockets where dirt and moisture might collect, increasing the possibility of galvanic action. Since aluminum alloys and steels cannot be welded together because of the wide difference in their melting points, joints must be bolted or riveted. In the shipbuilding industry "fairprene" PAW tape has been widely used as a seal between steel and aluminum alloy plates for the prevention of galvanic corrosion and to provide waterproof joints. This tape consists of a relatively thin strip of synthetic rubber of the neoprene type coated with a suitable adhesive. The adhesive normally used on this product is not oil resistant. Therefore it is not recommended for use on oil storage tanks. A neoprene sheet material without adhesive is suitable for such service, a strip 1/32 inch or less in thickness being inserted between the steel and aluminum alloy plates where they are joined by bolted or riveted lap joints. "Alumilastic," a caulking compound available in seven standard consistencies, has been recommended as a suitable seal between dissimilar metals. Consistency B, with zinc chromate added, can be applied with a brush but may prove to be too light in body to produce a well-packed joint, unless the worker is careful to apply the material uniformly and to not brush it out so thin that the joint is not well filled when drawn. To obtain a lasting, tight, void-free joint it is recommended that enough of either consistency CB or C be applied to one of the faying surfaces with a caulking gun so that a small amount will extrude at the edges when the joint is drawn by bolting or riveting. In some installations a strip of soft aluminum plate has been inserted and caulked in such joints; however, it is believed that either of the procedures just suggested will produce a better and more economical joint, free from danger of serious galvanic corrosion.

Aluminum Roofs on Bolted Tanks

Aluminum roofs have been used on many steel tanks furnished in accordance with API Standard No. 12-B by several companies. In most cases 0.144 inch-thick 3S aluminum alloy sheets were substituted for the 12-gauge steel sheets normally used and structural roof supports of equivalent strength made of 61S-T aluminum alloy replaced the conventional steel rafters. The usual methods of fabrication, including punching, curving and flanging, were employed without any difficulty. In a few cases aluminum alloy bolts have been used. However, these are relatively expensive and some trouble with the bolts being twisted off in tightening has been reported. Galvanized steel bolts are generally used. Rubber gaskets are used in all joints of bolted tanks and these seem to be adequate to prevent galvanic action. Welding used in connection with such tanks is only for manhole domes and similar fittings and occasionally for rafter rings.

Aluminum Roofs On Riveted Tanks

From 1928 to 1946 a relatively large number of riveted aluminum roofs were installed on riveted steel tanks, in most cases replacing steel roofs which had been destroyed by corrosion caused by vapors from sour products. The Texas Company has two tanks 30 feet in diameter by 12 feet high used in steam still rundown service with 10-gauge aluminum roofs installed in 1936 and two similar tanks 42 feet in diameter by 15 feet high used in sour naphtha rundown service with ¼-inch thick aluminum roofs installed in 1938. The aluminum roof sheets are riveted to each other and to supporting steel channel rafters located on the outside of the tank. At the shell the aluminum sheets are riveted to shell

top angle which is made of steel and no gaskets or other protecting seal material was placed between the aluminum sheet and the steel angle. The products stored in these tanks came from West Texas-New Mexico crude oils. As of late 1947, it was reported that there was no evidence of galvanic corrosion taking place between the dissimilar metals nor had there been any thinning or weakening of the roof. Aluminum rivets were used and some difficulty was experienced due to stretching of the rivets attaching the roof sheets to the bottom flange of the outside roof rafters.

Humble Oil & Refining Company, 1928-35, at Baytown, Texas installed aluminum roofs on eight steel tanks 30 feet in diameter and 10 feet high, and on 19 steel tanks 43 feet in diameter and 10 feet high. These were all rundown tanks and were used for a variety of stocks. The supporting rafters were of steel and were located on the upper side of the roof plates. The parts were assembled by riveting. The writer understands that, in general, no special precautions were taken to prevent galvanic corrosion between the two dissimilar metals, although one report indicates that soft aluminum strips were used between the steel top angle and the aluminum roof plates on some of the tanks. As of late 1944, after most of these tanks had been in service for 10 years or more, it was reported that the aluminum roof plates themselves had effectively resisted corrosion by the sulfur vapors but that localized galvanic corrosion had occurred where the aluminum plates were in contact with steel. The tank top angle was of steel and it was at this connection that the corrosion was most severe. An outside top angle was used and as a result there was a recess or pocket which would tend to trap condensation running down the inside of the roof sheets and thereby create a condition favorable to galvanic corrosion. Current recommendations avoid this type of connection detail. Humble Oil & Refining Company reports favorable results for steel roofs protected with reinforced gunite.

An aluminum floating roof designed by Shell Oil Company recently was erected at a Texas plant.

Sinclair Refining Company reports construction of several small (10 feet 6 inches diameter by 18 feet high) all-aluminum tanks built of 3/16- and ¼-inch thick material conforming to 2S-O specifications. These tanks, used for storing fatty acids, were designed for riveted construction but it was found that driving rivets enlarged the holes in the softer plate and made it impractical to obtain tight joints. As a result the plate edges were sheared off and the tanks were assembled by welding.

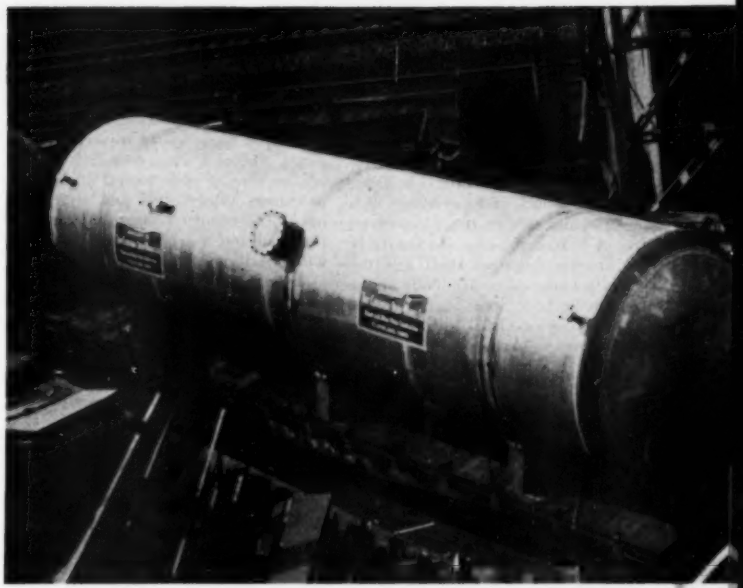
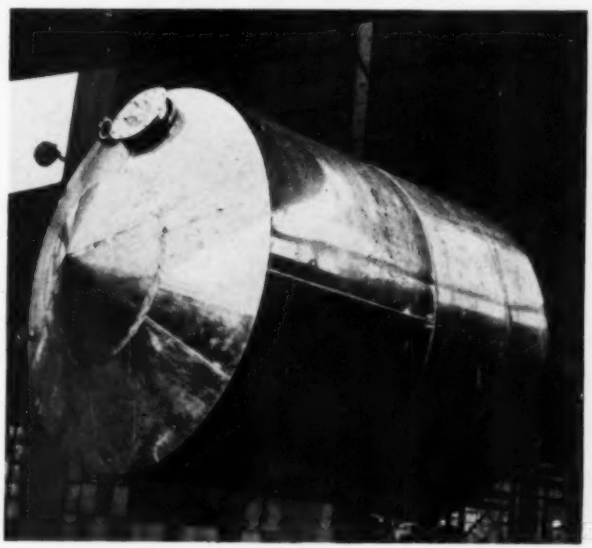


Figure 9. Aluminum Storage Tank for Acetic Acid.

Figure 12 shows one of the largest and most recent installations of a riveted aluminum roof on a steel tank. The roof was fabricated for Gulf Refining Company's Sour Lake tank farm near Beaumont, Texas: is a 55,000,-barrel steel tank having an outside diameter of 114 feet 6¾ inches at the top angle. The top angle (3 x 3 x ⅜ inch), rafters (7-inch channels), rafter clips, girders (15-inch channels built of two 3 x 3 x ⅜ inch angles and a ⅜-inch plate, 14½ inches wide), splice plates, center column cap (½ inch thick) and roof plates (5/32 inch

Figure 10. Aluminum Tank with 1½-Inch I.P.S. Aluminum Coil. (Photos on this and opposite page courtesy The Colonial Iron Works Company.)



thick) were all made of 61S-T6 alloy. The tank shell and bottom, and the columns including top bearing plates are steel. A ⅛-inch thick strip of 2S alloy was inserted between the inside aluminum top angle and the steel shell plate, the two being riveted together with ¼-inch diameter aluminum rivets. The soft strip was caulked in order to prevent liquid from entering this connection and accelerating electrolytic action. A 1/16-inch strip was similarly used between the steel shell and the rafter clip connection. The ends of the top angle pieces were butt welded using the argon-shielded tungsten-electrode arc-welding process. Strips of 2S alloy, ¼ inch thick, were placed between the column top bearing plates and the aluminum girders and the aluminum center column cap plate. The roof plates were assembled with aluminum rivets, the rafters and girders being field assembled with aluminum bolts.

In order for shop-fabricated aluminum parts to fit properly in a steel shell in the field it is essential that the temperature of the parts when laid out in the shop be essentially the same as when they are erected in the field or that the difference in temperature be estimated and a correction made to compensate for the difference in coefficient of thermal expansion for the two materials. It is understood that part of the erection of this tank was done at night because of the large difference in air temperatures in Chicago where the roof was fabricated and in Texas where it was erected. No difficulties due to differential expansion properties of the steel and aluminum have been reported since the roof was installed and the tank placed in service. Details of the roof construction and the general layout of the roof and roof supports are shown in Figure 12. As of early 1948, after the tank had been in service for about two years, it was reported that the roof appeared to be in good condition and that no trouble of any kind had been observed.

Field Welding of Aluminum Roofs

Until recently it has not been considered practical to attempt to weld the seams of aluminum roof plates on large field-erected storage tanks. The problems of flux removal and flux contamination have largely precluded the use of gas welding, arc welding with flux-coated metal rods and similar welding procedures. Recent developments in the use of the inert-gas-shielded tungsten-electrode arc-welding process have progressed to a point where this can be considered as a possible practical and economical method of field-welding aluminum roof plates. No welding flux is used and there is therefore no danger of flux contamination and no cleaning operations are required. G. O. Hoglund[12] states that this "is the only method that is suitable for making fillet and butt welds in the overhead position. Position welds in a vertical plane can be made more easily and uniformly by this method than by any other welding method." The resulting welds are sound and have excellent mechanical properties. Alternating-current arc in argon gas is recommended for welding aluminum. Standard equipment including a.c. welding transformers combined with high-frequency arc stabilizers, water-cooled welding torches, argon regulators and flowmeters, and other auxiliary equipment, is available from several manufacturers. At least one manufacturer now supplies equipment suitable for use in the field where a central electric power source is not available, and another company builds an engine-driven generator which supplies power to equipment similar to that used in the shop.

Recently completed and installed is a welded aluminum roof on a small oil storage tank, the top angle, channel roof supports and roof plates of which are all made of 61S-T6 aluminum alloy, the roof plates being 3/16-inch thick. The top angle is riveted with aluminum rivets to the steel shell. In order to provide a comparison of the resulting galvanic action, if any 1) a part of the aluminum angle ring is riveted to the steel shell with the two metal surfaces in direct contact (no attempt being made to prevent galvanic corrosion), 2) a part of the angle ring is separated from the steel shell by a neoprene gasket and 3) the remainder of the angle ring is separated from the steel shell by a layer of "alumilastic," brushing consistency B and caulking consistencies CB and C being used for different sections. The roof plates are welded to each other and to the horizontal leg of top angle with fillet welds, lap joints being used. The welding was done using a water-cooled tungsten electrode and argon gas for shielding the work. A crude portable screen was used to protect the work from air currents.

Figure 13 shows a view of two aluminum tanks constructed by Celanese Corporation at their Cemcel plant, Bishop, Texas. These tanks, completed early in 1948, and used for the storage of acetic acid, are 38 feet in diameter and 24 feet high, with a storage capacity of 200,000 gallons each. All plates

Figure 11. Field Welding of Aluminum Alloy Pipe Line for Crude Oil. (Photo courtesy Aluminum Corporation of America.)

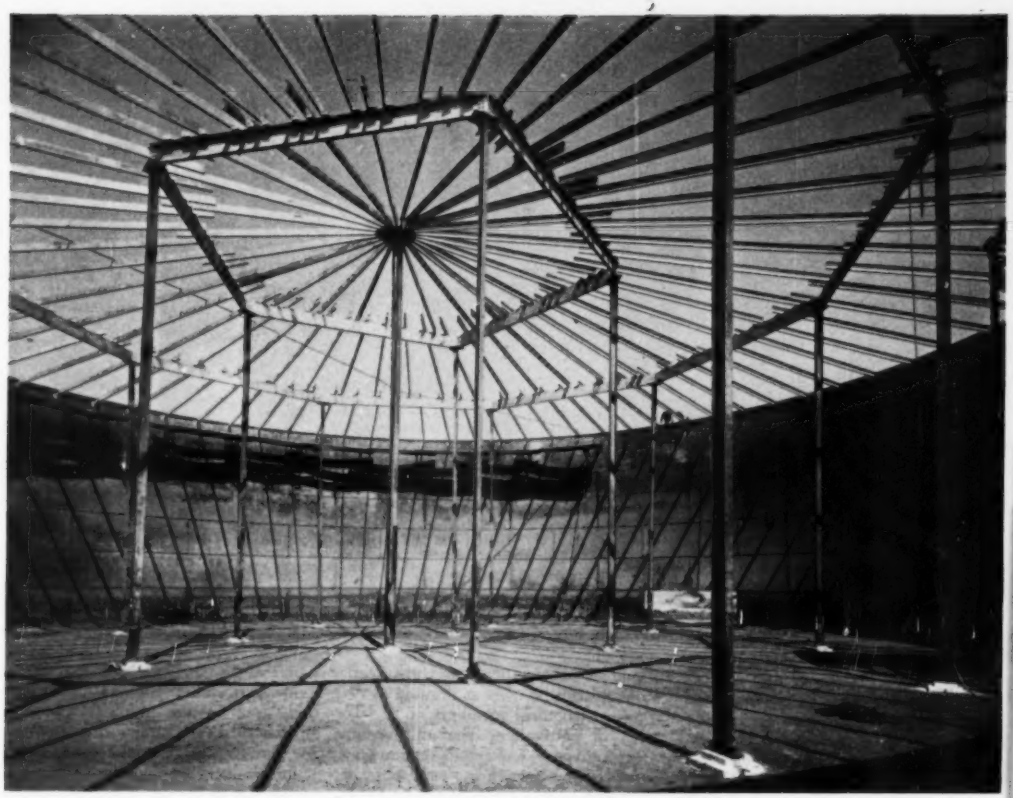


Figure 12. Large Steel Tank with Aluminum Roof. View Shows Aluminum Rafters and Girders on Steel Columns. (Photo courtesy Aluminum Corporation of America.)

are of 3S aluminum alloy, used as-rolled with H12 to H14 hard temper. Plate thicknesses in inches are as follows: bottom 3/8; shell first ring 19/32; second ring 7/16; and third ring 5/16; roof 5/16.

Figure 13 shows a general view of the two completed tanks. An umbrella type of self-supporting roof is used, the individual sketch plates being rolled in the radial direction and flanged at the shell for lap welding to the shell top angle. This angle is made of 61S-T aluminum alloy. The shell plates were all double beveled for butt welding. The tee joint used to connect the shell to the bottom plates is clearly shown in Figure 13, which also shows a manhole and anchor brackets. Note that the details for the manhole are similar to those normally used for tanks constructed of steel. Fillet welds were used to connect manhole flange, neck, reinforcing plate and tank shell. It is probable that these welds were made down hand before the shell plate was erected in its final position. The anchor brackets were attached after the shell plates were assembled, thus requiring the side welds to be made in the vertical position. All welding was done by the argon-shielded tungsten-electrode arc welding process.

Recommended Designs for Aluminum Roofs

The Aluminum Company of America has made a careful study of the design of large petroleum storage tanks and has prepared a series of recommended designs for roofs of diameters from 30 to 120 feet. These designs are the result of an effort to develop the best and most economical roofs possible giving full consideration to past experience and making use of the alloys and fabricating methods now available. The designs are shown on a series of drawings together with the corresponding bills of materials, and are available to those interested in the installation of aluminum roofs. These designs provide for the use of top angle, roof rafters and girders, roof plates (5/32 inch thick) and miscellaneous details, all made of 61S-T6 alloy or equivalent. The roof plates are joined to each other and to the top angle with lap joints, fillet welded on the top side only. The argon-shielded tungsten-electrode arc-welding procedure is specified.

The top angle is riveted to the steel shell with 53S-T61 alloy rivets or steel rivets may be used. The structural members are field assembled with 24S-T alloy nuts and bolts with No. 205 "alumilite" finish or galvanized steel nuts and bolts may be used. In order to prevent galvanic corrosion it is recommended that the faying surfaces of the riveted and bolted joints be painted with zinc chromate paint before assembly and that a 1/4-inch thick plate of 2S alloy be placed between the steel column cap plates and the aluminum alloy roof supports which rest on the steel columns.

Reynolds Metals Company has also prepared typical designs for aluminum roofs.

Alloy 3S or equivalent may be used for the roof plates if desired but the

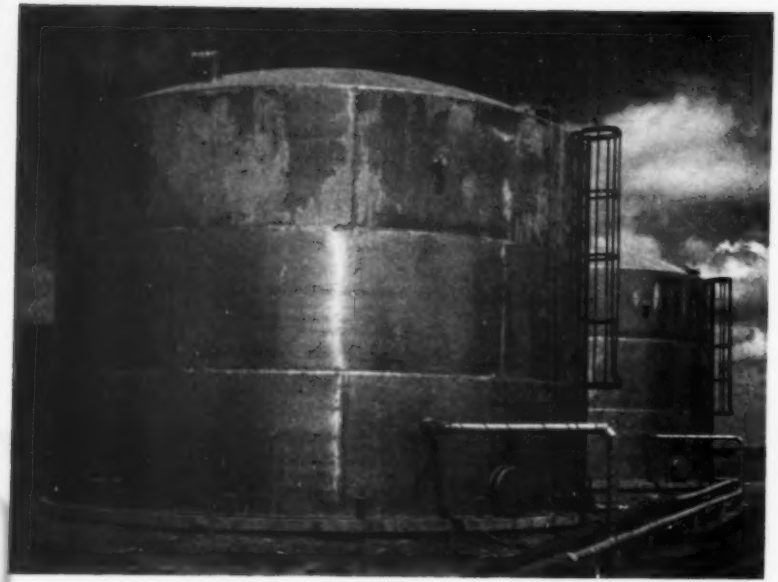


Figure 13. Two Aluminum Tanks for Storing Acetic Acid. (Photo courtesy Celanese Corporation.)

thickness should not be less than 3/16 inch so that the cost is approximately the same as for 5/32-inch thick roof of the more expensive and higher strength alloy 61S-T6. Steel tanks used to store petroleum products are usually equipped with conservation vents set to open at a pressure of not more than 0.85 ounces per square inch, this being the approximate weight of 3/16-inch thick steel roof plates. If valves set for approximately 3/4 ounce per square inch are used on tanks with aluminum roofs, the roof plates will lift off the supporting rafters (to which they are not normally attached) and a slight flexing of the plates will result in a mild fatigue effect. Experience has not indicated that this effect would significantly reduce the service life of aluminum roofs. In order to eliminate completely this effect, valves set to operate at 1/4 ounce per square inch or less must be used. Some operators have indicated that these values fall below the minimum limit necessary for practical operation of such valves.

The deflection of aluminum roofs under applied loads will, in general, be greater than for steel roofs of equivalent strength, but such greater deflections would normally create no hazard or operating difficulties. As previously noted steel and aluminum alloys have widely different coefficients of thermal expansion; however, there is no evidence of any damage to existing installations of composite tanks due to this difference. It is recommended that the precautions outlined in the section describing galvanic action between steel and aluminum, be followed in order to minimize galvanic corrosion.[7]

Suggested specifications[10] are available and can be used as a guide in designing structural members of 61S-T6 alloy or equivalent. The unit design stresses given in a previous section may be used for plates. For shell plates of aluminum alloy, 3S-F and 61S-T6 or their equivalents are recommended. The first of these alloys can be economically used in all aluminum welded tanks up to a size of about 35 feet in diameter by 20 feet high. The second alloy with a higher strength, even after welding, can be economically used for larger tanks. When the upper portion of a tank shell and the roof are made of aluminum, and the remainder of the tank is made of steel, construction similar to that described above may be used. The girth joint between steel and aluminum plates must be riveted and caulked, and suitably protected from galvanic corrosion. With some experience the aluminum-to-steel joint can be properly and economically caulked.

Comparative Costs

Because of the frequent changes during the past few years in the unit cost of construction materials and their handling and fabrication, it has been difficult to arrive at fair comparative costs of welded aluminum tanks or roofs and other types of construction having equivalent service characteristics. The writer has recently completed an extended series of cost studies made in cooperation with the development divisions of some of the major oil companies. These studies covered the types of construction described in this paper and others, including a special lightweight construction patterned after that used in the airplane industry. In general these studies indicated that for the storage of high sulfur petroleum products, welded aluminum roofs could, under many field conditions, compete on a favorable economic and service basis with steel roofs protected with gunite or other protective coating, and with steel roofs having the thickness of the plates and structural shapes increased to provide added corrosion allowance.

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Completed pressure vessel loaded at fabricating plant for shipment to process plant site. Since the paint program of the process plant begins with the priming coat applied to the bare metal of the vessel, surface preparation and paint specification included in the vessel's construction specifications provides logical starting point for combatting corrosion.

Shop Primers Important To Process Plant Paint Programs

JOHN W. NEE, Technical Director,
Napko Paint & Varnish Works, Houston

OVER the years the paint industry has achieved a steady and marked improvement in its products. Through heavy investment in research new materials have been developed and old ones bettered. Reliable and precise means for product quality control have been set up, and extensive investigation into countless specific applications conducted.

This progress in the manufacture of surface coatings is much to the advantage of process plant operators. The development of paint programs for the protection and appearance improvement of process equipment has in recent years been given increased attention by alert management groups. Some $15 million is spent annually for such purposes in refineries, gasoline plants, and petrochemical plants. In many process plants the careful evaluation of experience data is combined with paint manufacturer's recommendations to arrive at more or less standardized specifications for paint materials and application methods.

The paint industry today is more conscious than ever before of the need of customer education in the proper use of the complex compositions supplied currently as surface coatings. Members of the industry stand ready to advise and aid by rendering a real technical service, in the selection of the proper coating and in the correct application of these coatings so that the customer can be assured of receiving the fullest benefits of the materials resulting from a huge investment in research and development.

In general, quite satisfactory results can be achieved for the bulk of process plant paint applications. Well planned programs provide real economies in plant operation. The paint program, whatever it may be, should adequately protect the equipment that it serves. "Adequate protection" is roughly that level of painting maintenance which keeps plant equipment in service until it is finally retired for some cause other than painting neglect.

Typical good programs leave little to chance. Usually, specifications start at the "bare metal" level and proceed in considerable detail through all phases of materials choice and application technique, up to the color of the finish coat—for each type of plant equipment.

One serious fault, however, is common to may such paint programs. The program does not really begin until the equipment to be protected is received at the process plant site. One of the greatest mistakes made by the purchasers of process equipment is failure to specify the type of shop coat to be applied to the finished item by the fabricator before shipment. Due to this lack of shop coating specification, in detail, the purchaser frequently finds that the shop primer coat, though useful for equipment protection and

PAINT IS A secondary matter from the viewpoint of the pressure vessel fabricator. He is more directly concerned with meeting the rigid mechanical specifications for the construction of process equipment for his customers—the refineries and other process plants. Frequently the customer does not include adequate paint specifications in contracts for pressure vessels. Such vessels are nearly always carefully described for mechanical details. They are built under critical inspection to conform to the API-ASME or other codes. Paint may receive scant attention. It may be simply specified as "one shop coat" or not mentioned at all.

The fact is beyond dispute, though, that process plant paint programs begin with the first application of paint to bare metal—usually the shop coat put on by the fabricator. Too often this priming coat is not a suitable base for the application of additional paint coatings at the customer's plant. The principal reasons for this wasteful situation are poor surface preparation before the primer is applied and poorly applied or inferior primers. Often the shop primer must be removed in the field. This means that the plant paint program is off to a bad start. Quite a bit of money is wasted before the program reaches its logical starting point. This waste should be eliminated.

Paint specifications for shop coats and metal preparation should be developed by process plants to conform to their general paint programs and should be included in contracts with fabricators. The personnel of the fabricating shops are reasonably well informed on paint practices. Properly advised by the customer, they can certainly meet any paint specifications that may be set up. Paint specifications remove all doubt as to the desired procedure. Since the customer ordinarily has an inspector at the fabricator's plant for mechanical inspection of equipment, it should also be a fairly easy matter to obtain close adherence to whatever paint specification may be desired.

appearance improvement during shipment, is of little permanent value. In many cases this shop coat proves a liability. Surface preparation and the choice of the primer coat are without question the most important single factors in any painting application.

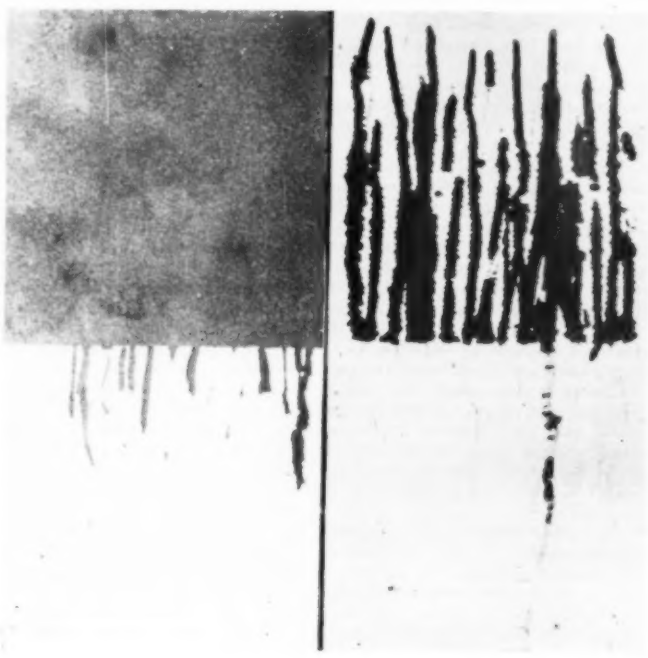
Many times it is better to receive process equipment in an unpainted condition and to paint it after erection at its permanent site, than to receive it coated with a badly applied or inferior type of primer, over which the most scientifically designed and finest quality top coat will not be able to yield its maximum protection. It must be understood that the durability of any coating is measured largely by its adhesion to the surface to which it is applied, and by its own film cohesive qualities. If we should remove one of these qualities (the ability to adhere), then the second quality (film cohesion), is of little avail.

Figure 1, is used to illustrate this claim. It is an aluminum panel, coated over half of its area with a wash primer[1] and the other half is bare clean aluminum metal. Over this surface was applied one coat of an industrial white baking enamel. When the panel is scratched over the entire surface, the white enamel flakes and peels from the unprimed area, and over the primed surface the white enamel exhibits both its adhesive and cohesive qualities to best advantage, by being intact and in excellent condition, as revealed by strong resistance to scratch.

Thus, by illustrating how much the lack of adhesion has influenced the qualities of this enamel, it is possible to point out that when good quality materials are applied over poor quality shop coat primers, which lack adhesion, then the entire film suffers and fails to yield maximum protection. The lack of adhesion is not the only inferior result these low quality primer coats yield, for they have little or no resistance to corrosive action, either atmospheric or chemical. Figure 2 shows the effect of using a very low grade of non-inhibiting primer under a high quality top coat as compared to a surface primed with a properly selected primer, when exposed to the attack of salt spray (20 percent NACl, 100° F., continuous fog). All panels were cross scored through to the metal before exposure.

Let us take, for example, the case of the purchaser who has ordered a new piece of equipment without specifying the type of prime coat required to meet his particular needs. As so often happens, the fabricator delivers the equipment with a shop coat of a non-inhibiting primer of little value beyond that of mere decoration. After the equipment is installed, the purchaser applies a high quality coating manufactured by a reputable firm, and all is well—but not for long. Premature failure of the high-quality

Figure 1. Steel panels, lower half only wash-primed and finished with conventional baking enamel. Left panel immersed in wash solvent illustrates improved solvent resistance of enamel when attack from edges under film is prevented by wash primer. Unprimed portion lifts immediately. Right panel shows result of repeated full-length scratching with coin.



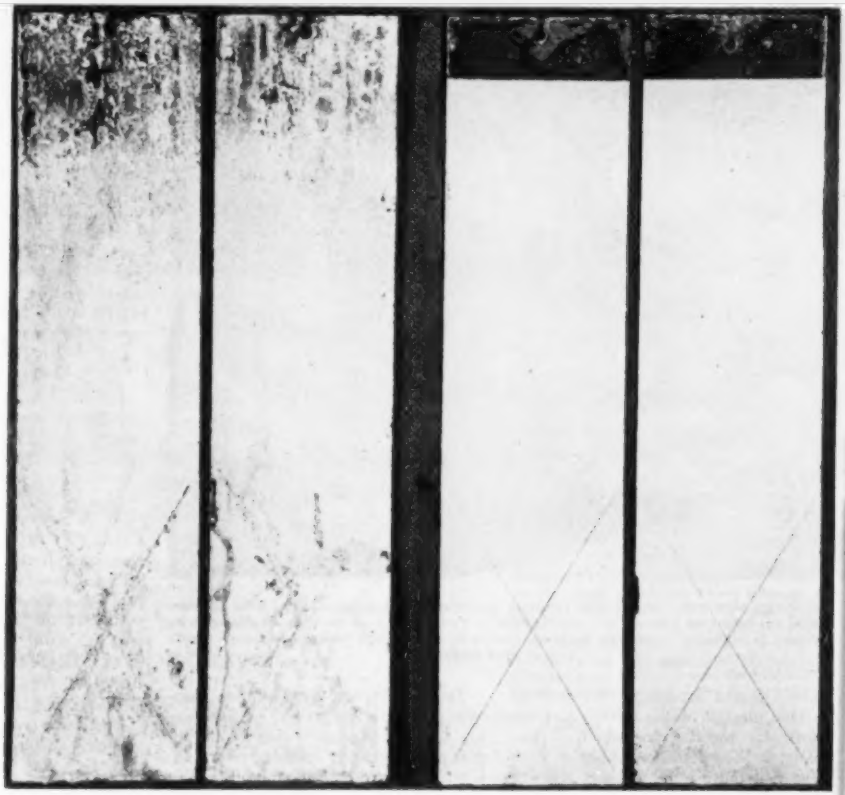


Figure 2. Effect of using very low grade of non-inhibiting primer under a high quality top coat (left) as compared with a surface primed with a properly selected primer (right) is shown here. These panels were exposed to the attack of salt spray and were cross scored through to the metal before exposure.

coating—entirely due to the inappropriate and poor quality primer beneath it—is not infrequently attributed to the manufacturer of the quality finish coat, who finds it difficult to defend himself without appearing to "pass the buck" to a competitive supplier, yet he faces loss of business and prestige of his valued trade-name.

Re-Priming

When such low grade coatings have been applied, then the only safe thing the erection crew can do to insure a high resistance, long durability surface protection result from their finish coats, is to sandblast it to the bare metal and re-prime, first having obtained from reliable sources advice on what type of prime coating to use. Now, insured of adequate adhesion and consequently superior cohesiveness of film, the painting crew can proceed with the appointed task of surface coating the vessel with the prescribed materials, being quite certain they will obtain all of the superior finish coat properties resulting from the manufacturer's extensive research and development.

Sandblasting an object almost always requires a large expenditure in money and time. It is true also in many cases that it would have been cheaper for the vessel to have been shipped raw, and sandblasted at point of destination, than to have primed it at the fabricating shop with worthless coatings requiring removal by sandblasting and re-priming at the ultimate erection point to insure good results. The purchaser has, in the latter case, paid not only for the first unsatisfactory primer but also for its application, so unless he is sure he has an adequate primer on the surface, he has lost money by allowing the fabricator to prime in the first place.

The only way to actually know what you are getting is by specifying the type and quality of the material your use of the fabricated piece indicates is required. The fabricating organization can usually be relied upon to follow specification instructions to the letter, and are normally quite capable of doing a good painting job. However, if in doubt, the buyer should have a representative on the job site to advise and inspect. This inspector may be either his own employe or the technical service man of his paint manufacturer, depending on who is better qualified, and how complicated the paint specification may be.

Shop Inspection

The fabricators of pressure vessels, designed to handle materials at high pressures and temperatures, must be very skilled in their trade. Their products usually must be approved by API-ASME inspectors, certified by the API-ASME code authorities, who inspect and examine each weld and every piece of plate for flaws in material or workmanship, to insure against loss of life and property by explosion and fire when the unit goes on stream. Note that inspectors present in the shop for vessel inspections can also inspect painting. While the paint industry makes no claims that paint will carry so heavy a responsibility, it does hold that adequate protection by paint films from the rigors of weather and other corrosive action will prolong the useful life of the unit. How great the amount of corrosion would have to be before structural weakness was ap-

Fabricating plant crew completing preparations for transporting pressure vessel to plant location. Vessel has been shop primed. Paint specifications in contract leave no doubt for procedure to be followed by fabricator in applying protective coating to vessel, which conforms to process plant's general paint programs.

parent would depend on the type of service, design of the vessel, and the particular metal from which it was made. It becomes more apparent each year that the use of properly selected and efficiently applied surface coatings is a necessity to insure against the loss of valuable equipment from exterior corrosion. When one considers the staggering sums lost to corrosion of all kinds each year in the petroleum industry[2] alone, it would seem that almost any effort would be worthwhile if it could materially reduce this loss.

The paint manufacturers of this country, together with the organizations who supply raw materials to the industry, have done their share in promoting better protection through improved coatings. They must now aid the users of their products in better utilization of the results of this expenditure for constant research, and they can only do this by continually pointing out the flaws in the system which allows the use of inferior products on expensive and vitally needed installations.

How better do this than by offering the aid of trained engineers to advise their customers, rendering the facilities of their laboratories and the technical skill of their employes to work on specific protection problems, and to merchandise the products of their industry in such a way that the customer derives full benefit?

To the designer, draftsman, engineer, specification writer, or purchasing agent responsible for obtaining new equipment the industry offers unlimited aid and assistance in obtaining the proper coatings. If, when the unit is on the drafting board, the paint manufacturer is called in, and all the functions of the particular vessel are explained to his engineers, the geographical location of the erected plant, the type of atmospheric conditions and pollution to be expected, then the competent technical staff of a paint manufacturer can write the specifications for the coatings and their application, which will yield the highest results in protection.

The cost of such service is rarely even a fraction of what is saved by having the painting done correctly. Such aid is rendered normally on a "consultant without fee" basis as a part of the technical service now considered standard practice by most reliable paint suppliers. Nor does it stop there, because the paint company desires its products to be used properly, they are usually anxious to supply capable personnel to advise the shop paint foreman and his crew on proper procedures, and to see that specifications are carried out.

With service such as this there is really no excuse for the purchaser to plead ignorance on the subject of paint, and when one considers that he will not hesitate to see that the products he buys for application to the unit on delivery must be of first quality, then so had he better investigate and specify the type of shop coat primer that will be on the unit when it is delivered.

Into any discussion of this type will always come the subject of cost. This is natural when corporations are desirous of making the best possible purchase with the funds appropriated for the job. Here also is where the prospective purchaser of heavy equipment should take a lesson from some of the heavy paint users of the nation.

Cost of Protection

The old idea of how much does it cost per gallon is now known to be of no value in determining the cost of paint protection. A good paint designed to protect a residence in a rural community may cost a known sum, and when compared to paint designed to protect a bubble tower in a chemical plant it would be cheap, yet no one would think of using such a product in the chemical plant. So paint will vary in price, depending on the type of paint required, bearing in mind that there are many complex formulae designed for specific purposes.

The same type of paint will vary in price depending on the solid content, i.e., that portion which remains on the surface after the volatile has evaporated. The higher the solids, the higher the cost (in the same formulation) and likewise the higher the protection in most cases, because protection depends to a great extent on the film thickness.

A really true guide to the cost of the paint used for protection should be figured on the formula—cost per square foot per year of protection. Under such a cost system the true cost of protection by paint is found. Cost per gallon gives no indication of the coverage (square feet per gallon of paint adequately coated), and even if it did, the length of life to repaint time must be considered because with each year of adequate protection the cost is materially reduced.

So it can be readily seen that the application of superior types of primers as shop coats by the fabricator of the unit will rarely cost more, but when specified, with the advice of a reliable paint manufacturer the ultimate cost in actual dollars will be less.

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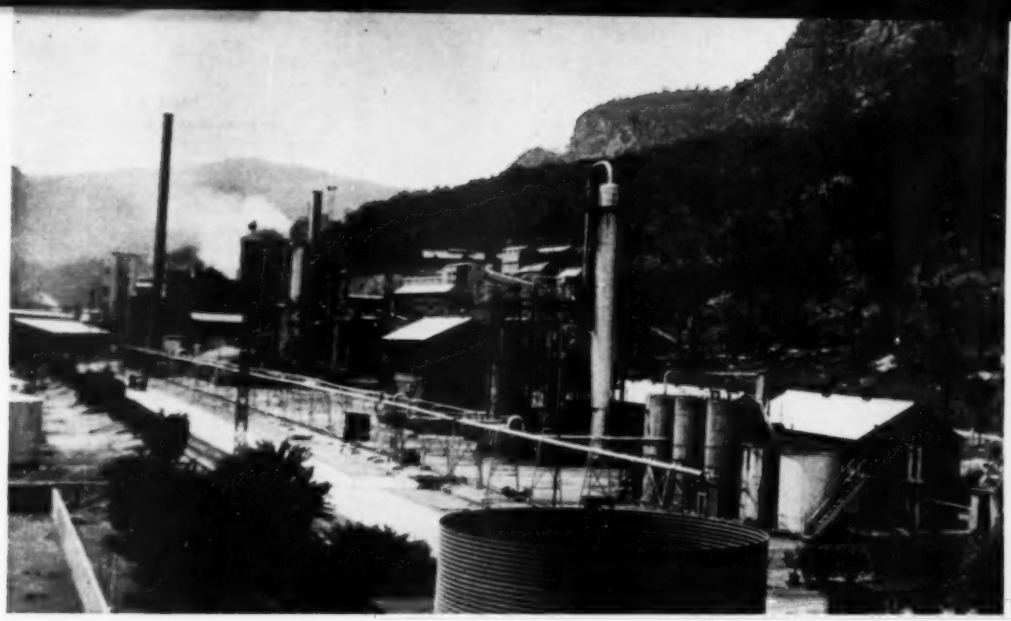

View of National Oil Pty. Ltd. refinery in Glen Davis, N.S.W., Australia. From left to right are the doctor plant, the Foster Wheeler re-run unit and the two-story brick building, the acid-treating plant. The cracking plant and power house are in the distance to the left of the acid plant. The shale crushing and handling plant can be seen behind the acid plants and behind them, some of the mine buildings.

Shale Tar Bases As a Gasoline Component

GEORGE E. MAPSTONE
National Oil Proprietary, Ltd., Glen Davis 6W, N.S.W., Australia

THE pressure distillate obtained by the thermal cracking of Glen Davis crude shale oil contains approximately 0.3 percent by volume of tar bases which are principally pyridine homologues. This concentration is small compared with that sometimes obtained in the oils from some American oil shales. Gavin, for example, remarked that many shale naphthas contain up to 10 percent of nitrogen bases[1] while McKee found 7½ percent of bases in the fraction of a DeBeque (Colorado) shale oil boiling below 300° C.

Because of the high boiling range of the tar bases, only a small fraction would be suitable for denaturant purposes (fraction to 160° C.), and at present there is little commercial application for the higher boiling pyridine compounds. The quantity that will become available in the future, as the shale resources of the world are exploited to a greater extent, will be such that some bulk use must be found for them. The high solvent power of the bases will probably be exploited by the chemical industries as they become available cheaply and in large quantities, but other outlets must be sought and developed as well.

The best initial outlet for these materials in bulk would naturally be in the main products such as gasoline or fuel oil. Any higher boiling bases could be readily disposed of in fuel oil, but their inclusion in the gasoline would be more profitable if it were possible to do so without affecting the quality of the product.

At Glen Davis, the acid treatment for the control of the sulfur content of the gasoline removes the bases almost quantitatively,[2] though recent evidence indicates that approximately five parts per million, by volume, remain in the treated product without any apparent effect on the quality. A brief survey of the literature suggests that the inclusion of the bases in the gasoline should not depreciate the octane rating. The antiknock properties of aniline lead to the use of the "aniline value" of a fuel as a criterion of antiknock quality before the development of the present octane rating scale. During the recent war, xylidines were added to aviation fuels to the extent of 1-2 percent in order to increase their rich mixture performance rating, but attention appears to have been concentrated mainly on the application of the aromatic amines, such as aniline and its homologues.[4] McDonald[5] has patented the use of pyrrole and its alkyl homologues, and distilled bone oil (pyridine homologues) as well as other nitrogenous materials for improving fuels for internal combustion engines.

Since pyridine and quinoline have been claimed as antioxidants for transformer oils[6] they might be expected to

THE PYRIDINES present in shale gasoline have a high octane rating and, if anything, improve the storage stability of the product. Pyrroles, which are also present, but to a much smaller extent, are active gum formers, and must be removed. If the pyridines could be economically recovered from the hydrolyzed acid sludge, they could be purified and returned to the treated gasoline. Alternatively, it may be possible to devise a new desulfurization process for the gasoline which would remove the pyrroles and not the pyridines.

Results described by the author indicate a possible outlet for the higher boiling fractions of coal tar bases for which the market is limited.

show some similar activity in gasolines.

The effect of returning the bases on the boiling range, octane rating and gum content of the gasoline was determined.

Boiling Range

A sample of the tar bases was isolated from the acid sludge as described previously[3] and purified by a single distillation (Sample A, Table 1). Different amounts were added to a sample of the gasoline and the effect on the ASTM distillation determined. The effect was not great, and was confined almost entirely to the end of the distillation, as was to be expected (Table 2). The results indicated that quite a large proportion of the bases could be blended in with the gasoline if required, without a great effect on the distillation range.

The octane rating of the same sample of tar bases was found to be 102 by the Motor Method. A very rich mixture was required to give maximum knock and some difficulty was experienced in obtaining ignition of the bases, probably because of their high boiling range. The blending octane number of the bases in clear and leaded shale gasoline was comparable with the value obtained directly (see Table 3 and Figure 1).

The spread of results obtained was probably due to the fact that the tests were not carried out on the same day. The results obtained indicate that the antiknock properties of the shale tar bases are only a little less than those of aniline and its homologues.[4]

Gum and Stability Tests

Preliminary work on the gum contents of gasoline samples containing added shale tar bases indicated that the latter contained a small proportion of some material which adversely affected the gum forming properties of the blends. A search for this active material and a method for its removal was therefore made so that the gum forming properties of the pure bases could be evaluated.

Pyrroles have well known gum and polymer forming properties, and upon examination, they were found to be present in the stabilized pressure distillate in small amounts. A sample of the neutral oil isolated during the purification of a sample of the tar bases was found to contain quite an appreciable proportion of pyrroles, as was expected in view of their very weakly basic character. The properties of the sample of neutral oil are given in Table 1. It contained 1.04 percent sulfur and 0.22 percent nitrogen, the latter being equivalent to a little over one percent of pyrrole by weight. The instability of this oil was manifested by its rapid discoloration on standing. The freshly recovered oil when distilled was yellow as it left the condenser, but the bulk of the distillate in the receiver was red. By the end of the distillation (standard ASTM) there was a one inch band of deep red oil on the top of the paler red distillate. Within an hour the whole of the distillate had turned a very deep red, and after several days it was a deep reddish brown and opaque. Unfortunately, it had not been practicable to carry out the gum and stability blending tests on the freshly distilled oil, so the strongly discolored sample was distilled just prior to use for the tests. The redistilled oil contained no pyrroles, those initially present appear to have been polymerized and resinified completely and were probably responsible for the large amount of coke obtained on the redistillation.

A sample of the pyridine bases was freed from pyrroles by refluxing for several hours 400 ml. of the crude bases with 300 ml. of concentrated hydrochloric acid and 150 ml. of water. This caused the complete polymerization of the pyrroles and the separation of an appreciable amount of tar. The acid solution was diluted

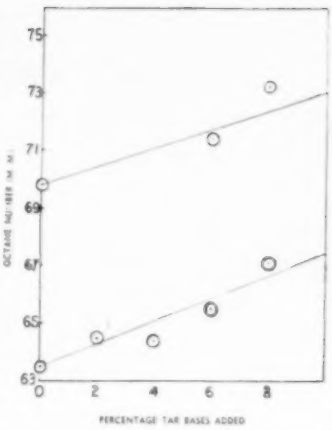

Figure 1
Octane Rating of Gasoline-Tar Base blends. (The empirical relationships are based on a blending octane number of 102.)

TABLE 1
Tar Bases Used in Blending Tests

Sample	A (For Octane)	B (Pyrrole Free)	C (For Gums)	Neutral Oil From Bases
Specific Gravity	0.935	0.928	0.932	0.873
Distillation, °F.				
I.B.P.	246	228	204	228
5%	342	346	344	271
10%	348	355	347	308
20%	360	359	355	326
30%	364	361	360	337
40%	368	364	364	352
50%	372	367	366	364
60%	378	370	372	379
70%	382	374	376	401
80%	390	379	384	.....
90%	402	389	400	.....
95%	413	395	403	.....
F.B.P.	436	414	420	434 88% over

TABLE 2
Effect of Added Tar Bases on A.S.T.M. Distillation

Bases Added Percent by Vol.	90% Point	95% Point	F.B.P.
nil	356° F.	373° F.	391° F.
4%	359° F.	375° F.	390° F.
6%	361° F.	378° F.	392° F.
8%	365° F.	384° F.	397° F.
10%	402° F.	418° F.	436° F.

View of the 1600-barrels-daily Dubbs unit for cracking crude shale oil. In the distance to the left is the powerhouse in front of which are the Dubbs furnace and stack. The UOP polymerization unit is to the right of this photograph along the pressure distillate stabilizer.

with an equal volume of water and filtered to remove the tar and traces of neutral oil. The bases were liberated by the addition of a slight excess of 40 percent caustic soda solution, filtered and distilled (Sample B, Table 1). The pyrrole-free bases did not discolor on standing for several weeks, while samples of tar bases which had not been purified in this manner usually discolored on standing overnight. Consequently, the bases did not need to be redistilled before carrying out the gum and stability tests.

Since the presence of ammonia increases the rate of atmospheric oxidation of copper due to the formation of complex copper ammine ions, and similar complexes are formed by cupric ions with pyridine and its homologues, it was thought that the presence of such compounds in the gasoline might promote corrosion of the copper fittings in the fuel system of an engine. The fact that even one or two parts per million of dissolved copper can have an extremely adverse effect on the storage stability of the gasoline, would probably be much more important than the actual corrosion. The effect of the addition of a copper deactivator together with the tar bases and the neutral oil on both the ASTM and copper dish gum content of the gasoline was therefore determined. The deactivator used was DuPont metal deactivator, which consists of a 20 percent solution of N,N'disalicylidine 1.2-diamino propane in xylene.

The results (Table 4) showed that the presence of up to one percent of pyrrole-free bases had no effect on the gum content of the gasoline, while the unpurified bases (Sample C, Table 1) and the redistilled neutral oil caused a significant increase. The results also indicated that the addition of copper deactivator was unnecessary. The gum forming propensities of the pyrroles were well demonstrated by the behavior of the neutral oil mentioned earlier.

The storage stability tests, which were carried out according to UOP Method H-6 - 40,[7] confirmed the deleterious effect of the neutral oil even after it was freed from pyrroles (Table 5). The pyrrole-free tar bases showed a slight stabilizing action. This observation is supported by the claim that pyridine and quinoline may be used as antioxidants in transformer oils.[6]

The results obtained in this work indicate that the pyridine homologues can be used as a valuable constituent of the gasoline. With present methods involving acid treatment the bases could be recovered and blended back into the final product after removal of pyrroles if the recovery and subsequent purification proved to be economical. Such a process could involve the hydrolysis of the acid sludge from the treatment process (as is at present carried out at Glen Davis), heating the dilute acid solution sufficiently to polymerize all the pyrroles, followed by separation of the tar and the liberation of the bases by means of an alkali. The crude bases thus recovered would need to be redistilled before being incorporated in the final product, but it should be possible to blend them with the acid-treated gasoline charge to the rerun unit, and thus eliminate the necessity for additional distillation equipment. Alternatively, it may be possible to devise a method of treating the gasoline which will provide the necessary desulfurization and also remove the pyrroles without extracting the pyridines. Such a scheme of treatment is at present being investigated.

The results presented here also indicate a possible outlet for the higher boiling fractions of coal tar bases for which the market is limited.

View of the retorts and condensing system, same Glen Davis plant. The mine buildings are up the hill to the left behind the retorts. The 90-foot absorption columns are visible in front of and standing higher than the retort bench. The 50,000-cubic-foot gasometer on the right acts as a pressure stabilizer for the gas fuel system. The road in the foreground is made of spent shale.

TABLE 3
Octane Rating of Gasoline-Tar Base Blends

Bases Added Percent by Volume	Octane-Rating—Motor Method	
	Clear	+1.5 cc. T.E.L. /imp. gal.=1.25 cc./U.S. gal.
nil	63.5	69.8
2%	64.5	
6%	64.4	
6%	65.5	71.4
8%	67.1	73.2
100%	102	

TABLE 4
Gum Contents of Gasoline-Tar Base Blends
(Results are quoted as mg./100 ml.)

Percent Additive by Volume	Purified Bases		Unpurified Bases		Neutral Oil	
	c.	d.	c.	d.	c.	d.
A. ASTM Gums						
nil	1.2	2.9	0.9	0.5	2.4	2.3
0.14%	1.2	2.9	1.7	1.3	2.4	2.4
0.29%	1.2	2.9	2.6	1.8	2.8	4.3
0.43%	1.3	2.6	2.9	2.4	3.7	4.2
1.00%	1.2	2.9	2.8	3.9	4.3	4.5
B. Copper Dish Gums						
nil	15	24	12	13	16	20
0.14%	17	29	24	23	18	24
0.29%	14	25	22	27	19	25
0.43%	10	23	18	24	19	21
1.00%	14	21	34	38	56†	38

† Stood one day after blending before testing.
c. = Clear.
d. = plus 0.0014 percent of Du Pont Metal Deactivator.

TABLE 5
Stability Tests

Shale Gasoline	Induction Period	Difference
Clear	1350 min.	
Plus 1% pyrrole-free bases	1425 min.	+75 min.
Plus 1% redist. neutral oil	1140 min.	−210 min.

ACKNOWLEDGMENTS

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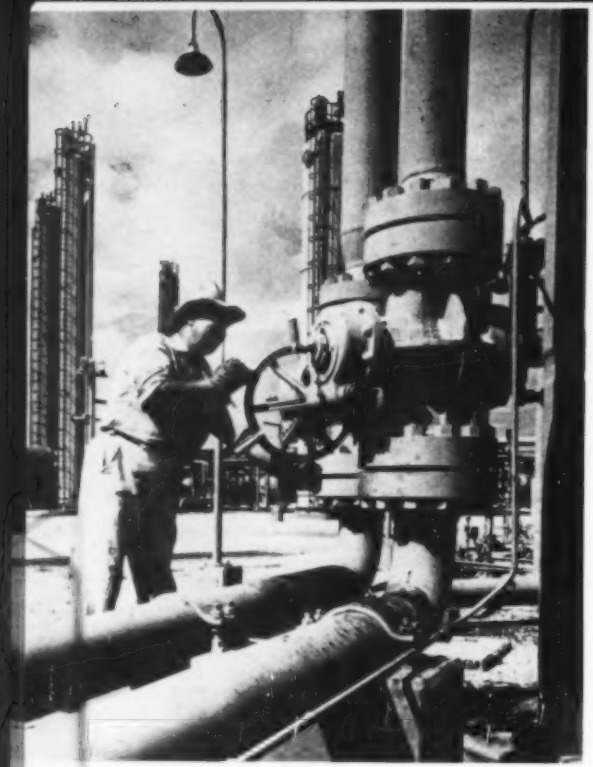


Automatic Lubrication For Refinery Valves

Re-lubrication frequency reduced by "Hypermatic" development

IN refineries where there is a multiplicity of pressurized lubricated valves of the plug type, maintenance costs are predicted to take an appreciable drop, by the use of a phenomenal lubricant which has been in the course of development for many years.

From the research laboratories of Nordstrom Valve Division, Rockwell Manufacturing Company, comes the news that automatic lubrication has arrived and will be made available to the users of the more than 5 million valves of the plug type now in service with limitations only as to high temperatures.

The problem of relubrication of pressurized valves has long been an obstacle recognized by both manufacturer and engineer. To maintain proper valve lubrication, the pressurized valves should be kept as close to a 100 percent status as possible. This has necessitated frequent relubrication, in many instances daily service in the case of those frequently operated.

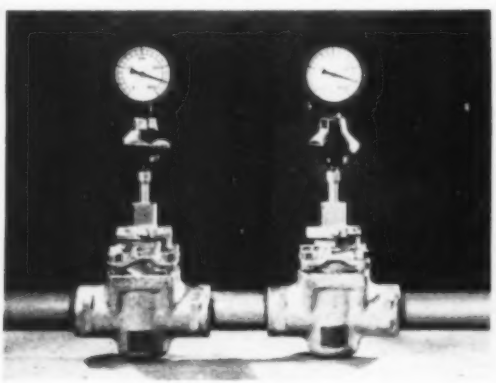
In the case of pipe line valves remotely located, this has posed even more of a problem because the valves are infrequently lubricated yet must be ready to be instantly opened or closed in an emergency.

In refineries where the valves are more or less grouped, the assignment of maintenance men has been necessary to see that every valve is in an operable condition to reduce to a minimum the chance for leaks.

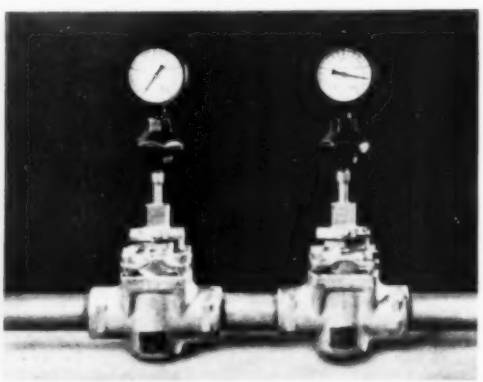
Christened "Hypermatic," the new lubricant can be applied to any pressurized plug valve of the plug type presently in service and does not require dismantling of the valve to clean out the old lubricant. It will replace the old lubricant within a short time and will become fully automatic in action by pressurization. It is injected into the valve the same as any lubricant—by a grease gun, or by inserting the stick form. Turning of the screw imposes hydraulic force which impounds energy within the lubricant itself. Oddly, Hypermatic is compressible and expansible—unlike any other lubricant. It has properties that give it the facility to store the energy and use it when needed in case a leak occurs. Should a leak start, the lubricant will flow through the channels on the plug and on the interior seat of the body and promptly close the leak. Energized pressure can be built up to practically any desired pressure but the lubricant will flow to as low a pressure as 50 pounds. Of course, the higher the line pressure the higher the energized pressure should be.

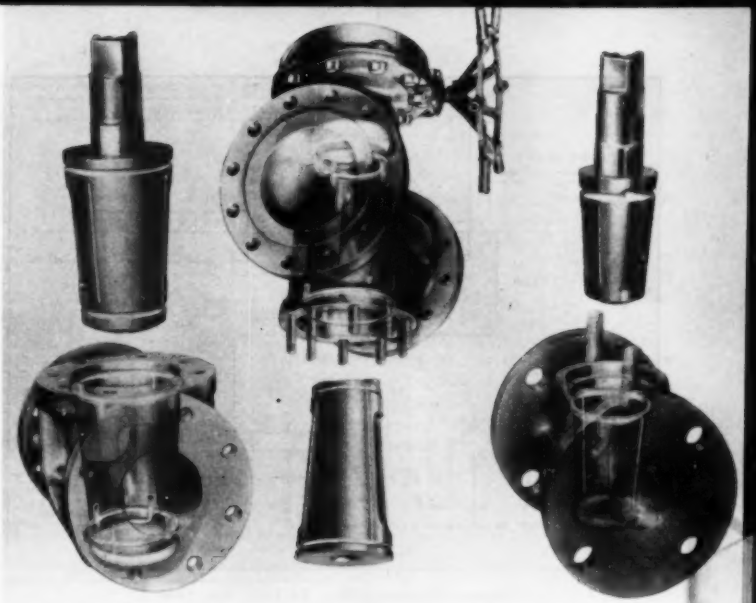
In the case of non-energizable lubricant, pressure quickly declines because it is incompressible and therefore necessitates

Below: Valve at left is pressurized at 350 psi. with non-energized lubricant on a test line. Valve at right, of identical type, is pressurized to 350 psi. with automatic energized lubricant.



Below shows same valves six months later. Valve at left shows that pressure of non-energized lubricant has dropped to 0 psi. Valve at right with energized lubricant shows negligible decline in pressure.





Right: Three types of Pressurized Plug Valves adaptable to Hypermatic lubricant. Plus show groove arrangements which connect with companion grooves in their respective bodies to form an unbroken circuit. By turning lubricant screw inserted in top of plug, hydraulic pressure energizes Hypermatic lubricant and stores energy within the valve's reservoir for future use. (Cover plates omitted for clarity.)

frequent turning of the screw to again build up pressure; whereas Hypermatic is flexible and is capable of storing within itself a tremendous power that causes it to flow in the event of a leak.

As a demonstration, a test valve is filled with Hypermatic and is partially opened to expose the short groove through the port. This groove is scraped clean of all its lubricant to simulate an exaggerated leak. Then the valve is closed and partly reopened within a few seconds to again expose the groove. It is fully filled, proving its instant action. Field engineers are demonstrating this amazaction by the use of transparent plastic valves so that the witness can see the instant flowing action from the top of the cleaned groove to the bottom.

For more than a year the lubricant has been on secret test in the field on various lines to authenticate every claim made by the manufacturer, and is now ready to be distributed and made available to refineries and to the oil and gas industry at large.

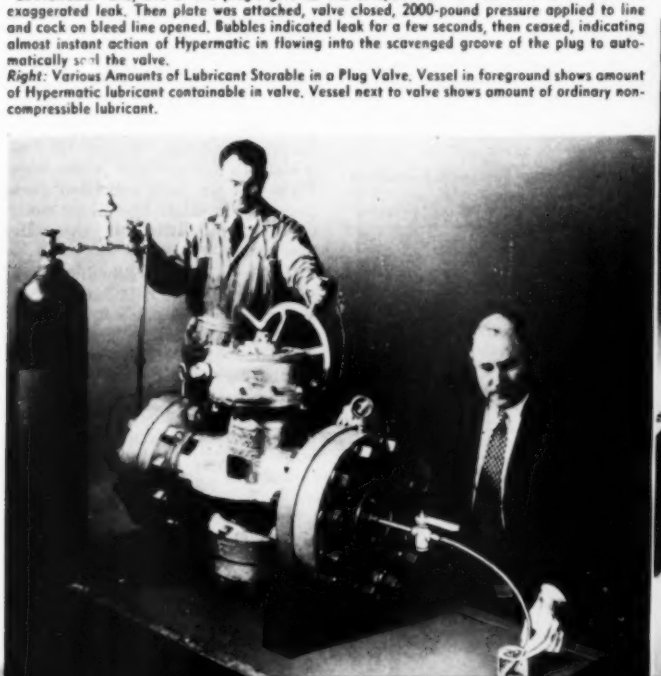
At the present time a conservative limit has been placed upon the range of temperature for the use of this lubricant. It has been set at 250° F. although tests are now being conducted to announce a higher temperature range later. Even on the higher temperatures the lubricant can be used but would probably assume, in most cases, the properties of the non-energized type. There are various applications of Hypermatic in refinery service.

The pressure range is complete for the use of the lubricant from vacuum to highest pressures on lines in refineries and it is adaptable to all sizes of valves of the plug type.

Probably the first reaction of a refinery engineer would be to assume a conclusion that the lubricant is merely based upon an inclusion of entrained gas. This falls short of explaining the phenomenal properties of the product which, according to George Scherer, Research Director in the Nordstrom laboratory, involves elements and processing far beyond the scope of compression. The application for patents pending precludes the disclosure of properties.

In effect, this new principle of lubrication actually creates a new design in pressurized valves without investment in equipment. Nothing need be purchased to convert present valves to automatic lubrication. The switch from old lubricant to the new type effects the conversion. The largest saving will be derived from the reduced amount of maintenance necessary, and greater safety and efficiency will be added by reason of the fact that the valves will be kept in a 100 percent lubricated condition, according to Scherer.

***Below:* Action of Hypermatic in a Plug Valve. Before end plate with hose was bolted to valve on "downstream" end, one of the plug's grooves was scraped clean of lubricant to simulate an exaggerated leak. Then plate was attached, valve closed, 2000-pound pressure applied to line and cock on bleed line opened. Bubbles indicated leak for a few seconds, then ceased, indicating almost instant action of Hypermatic in flowing into the scavenged groove of the plug to automatically seal the valve.**
***Right:* Various Amounts of Lubricant Storable in a Plug Valve. Vessel in foreground shows amount of Hypermatic lubricant containable in valve. Vessel next to valve shows amount of ordinary non-compressible lubricant.**



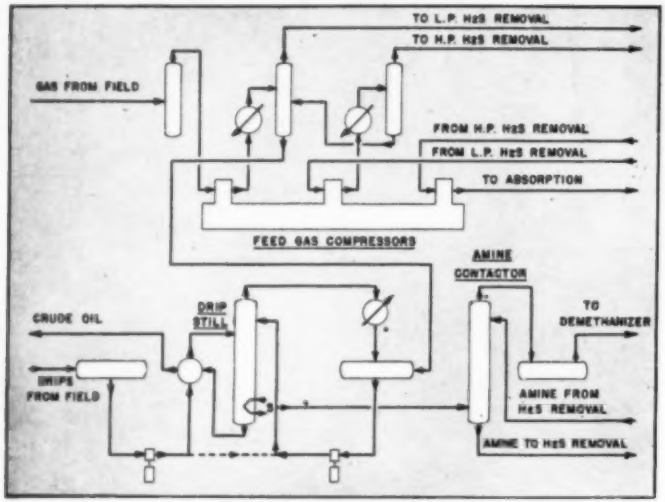


Figure 1. Compression Drips, Elk Basin, Wyo., Plant.

STANOLIND OIL and Gas Company is producing 74 long tons daily of commercial sulfur at its Elk Basin gasoline plant near Powell, Wyo., in addition to the high extraction percentages of propane, 19,100 gallons daily, butane, 20,200 gallons daily, and natural gasoline, 16,900 gallons daily. In addition, the plant produces inert gas for reservoir repressuring and natural gas of 1000 Btu. for pipe line sale.

Although, the production of commercial sulfur at a gasoline plant is not new, it is unusual. This is a completely detailed discussion of such an integrated operation and as such describes the design of both the gas and the sulfur extraction process.

In view of the demand for sulfur, this operation may well be the forerunner of other plants, built not only for the processing of gas for its liquid hydrocarbon content, but for sulfur and other products, such as carbon dioxide.

Elk Basin Plant Termed Real Conservation Project

L. R. LYON, R. A. FEAGAN, JR., and H. B. MANLEY
Stanolind Oil and Gas Company, Tulsa

THE Elk Basin plant, in addition to producing inert gas for injection into the reservoir and processing casinghead gas for recovery and utilization of the hydrocarbons, also produces sulfur. In most plants of this nature, hydrogen sulfide extracted during the sweetening operation is flared and vented to the atmosphere—a total loss. In the Elk Basin plant, this corrosive and toxic gas produces commercial sulfur.

A favorable factor in the recovery of sulfur at Elk Basin is the high content of hydrogen sulfide in the casinghead gas. At the time of discovery of the Embar-Tensleep reservoir, this casinghead gas contained the highest concentration of hydrogen sulfide encountered in any known production.

Field System

The Elk Basin oil field is located on the Montana-Wyoming border, 18 miles north of Powell, Wyo. The Embar-Tensleep produces from 124 wells and casinghead gas is collected from elevated separators at nine consolidated crude oil tank batteries in the field. The gas collection system is installed above ground on wooden ties and consists of about ten miles of pipe ranging from 6 to 22 inches in diameter. The collection system, consisting of two main lines, one from the north part of the field, the other from the south, is sized to deliver gas to the plant compressors at a pressure slightly above atmospheric, with field separators operated at 2 psig. Vacuum operation is avoided, in order to prevent possible air infiltration and thereby minimize potential corrosion by hydrogen sulfide. The gas collection system is designed with a minimum number of low spots as trap and accumulation points for line condensate or drips. These low points are equipped with underground drip collection tanks from which pumps, controlled by float operated switches, deliver the condensate to a surge tank at the plant. There are six such collection points from which small pipe lines run to the plant paralleling the gas collection system.

Package units for dehydrating casinghead gas at the field batteries were included in the design but as yet have not been installed. It is planned to determine by operating experience whether it will be necessary to dehydrate the gas in order to prevent freeze-up of the gas collection system during extreme cold weather.

TABLE 1

Feed Gas—Design Basis—Elk Basin Plant

COMPONENTS	Mol. %	MSCFD
Nitrogen	2.00	240
Carbon Dioxide	6.00	720
Hydrogen Sulfide	18.50	2220
Methane	41.75	5010
Ethane	15.50	1860
Propane	7.41	889
Butanes	5.20	624
Pentanes and Heavier	3.64	437
Total	100.00	12,000

TABLE 2

Products—Design Basis—Elk Basin Plant

Propane	19,100 Gal./Day
Butane	20,200 Gal./Day
Natural Gasoline	16,900 Gal./Day
Sales Gas @ 500 psig.	4,200,000 SCF/Day*
Inert Gas @ 1500 psig.	14,000,000 SCF/Day
Sulfur	74 Long Tons/Day

* Includes inert gas dilution to 1000 Btu. per SCF (Dry).

General

The plant design provides for the extraction of H_2S, CO_2, gasoline, butane and most of the propane from 12

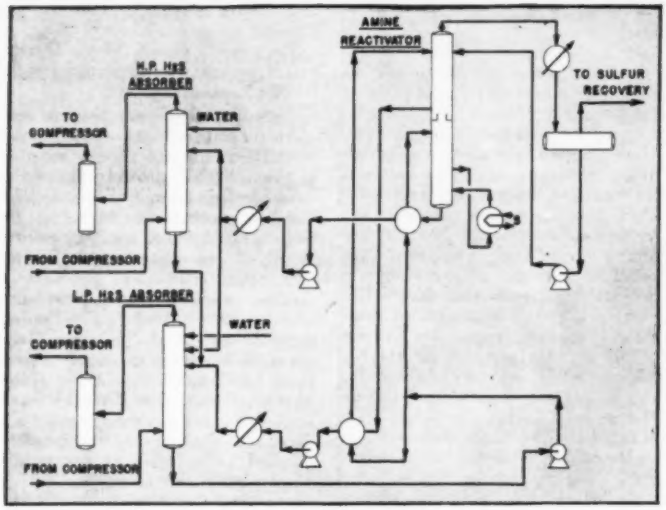


Figure 2. Flow Chart Showing H₂S Removal System at Elk Basin Plant.

million scf. per day of casinghead gas, producing a fuel gas suitable for plant boilers and compressors a residue gas in salable form at 500 psig., commercial sulfur and non-corrosive boiler flue gas at 1500 psig. for injection into the Embar-Tensleep reservoir.

Table 1 shows how the sweetening of the field gas by removal of H_2S and CO_2 leaves a gas rich in propane and heavier hydrocarbons. For recovery of these hydrocarbons, a number of process cycles were studied. The absorption cycle selected consists of a single intercooled high pressure absorber followed by 1) a reboiled absorber (demethanizer) operating at a lower pressure for partial stabilization of the rich oil, and 2) a single still for stripping the heavier absorbed hydrocarbons from the absorption oil. The plant was designed for 80 percent propane recovery. Design product quantities are tabulated in Table 2.

In conjunction with the preparation of inert gas, a steam power plant is provided to produce steam and electricity for the plant and part of the electric power required by the field; additional electric power required for the field and standby for the plant is purchased from outside sources. Boiler flue gas is dehydrated and compressed to 1500 psig. for injection.

Water for the plant, available from the system that was installed during the development of the reservoir, is pumped from the Clark's Fork River, 15 miles west of the field. Since plant make-up water is limited by this system to 5000 barrels daily and because air temperatures are quite low in this region, a large portion of the cooling is accomplished by air-cooled units.

Design of the cooling equipment is based upon an 80-85° F. dry bulb temperature and a 60° F. wet bulb temperature.

The plant is located on the east side of the mid-portion of the field, and has a general layout to conform with the terrain. The plant has been separated into two areas with one portion containing all fired equipment and the other portion containing all hydrocarbon processing equipment. The long axis of the plant is roughly from northwest to southeast to take advantage of prevailing winds for cooling purposes and to minimize snow accumulation.

Most of the plant processing equipment is outdoors, but buildings have been provided to house pumps, compressors, generators, and boilers. In addition, there is a main office and laboratory building, a loading rack ticket house, a garage, and a general service building. Also, a building has been provided to house certain of the sulfur recovery equipment.

Product shipment from the plant is by truck. Rail facilities are provided at Powell, Wyo., for trans-shipment of lump sulfur.

Field Gas Compressors

The plant field gas compressors (Figure 1) consist of three 3-stage 1000-hp. (sea level rating) 2-cycle, right-angle, gas-engine-driven units designed to compress a total of 12,000 mscf. per day from 12.7 to 540 psia. Because of the 4962-foot altitude, these compressors are de-rated to approximately 860 hp. each.

Field gas enters the plant through a scrubber designed to remove entrained crude oil, scale, and other foreign materials. Gas from this scrubber flows to the first stage suction header at 0.5 psig. and is compressed in the first stage of compression to 46 psig. The first stage discharge gas is cooled, passed through a separator and sent to the low pressure amine absorber where it is partially stripped of hydrogen sulfide and almost completely stripped of carbon dioxide. The

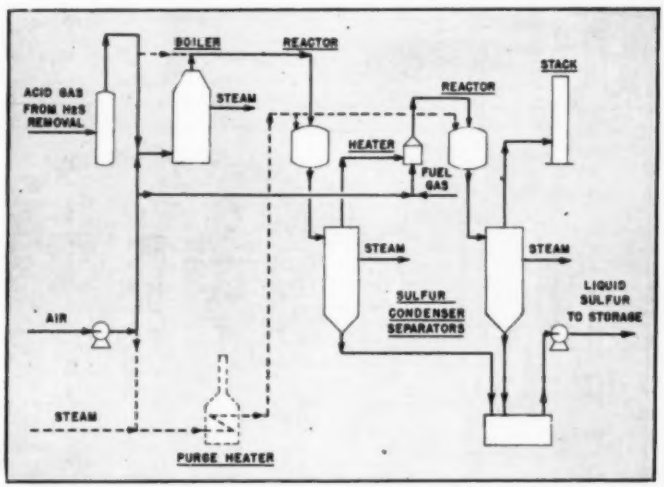


Figure 3. Sulfur Recovery System at the Elk Basin Installation.

gas is then further compressed to 152 psig. in the second stage, cooled, passed through a separator and treated in the high pressure amine absorber for hydrogen sulfide removal to a maximum residual concentration of 0.25 grains H_2S/100 scf. The sweet gas is then compressed in the third stage to 525 psig., passed through the third stage aftercooler and charged to the main absorber.

One of the inert gas injection compressors is manifolded to serve as a spare for the field gas compressors.

H_2S Removal System

A flow diagram of the H_2S removal system is indicated in Figure 2. Because of the high acid gas (H_2S and CO_2) content, it was found desirable to use a two-stage amine process for sweetening. This system removes hydrogen sulfide and carbon dioxide from the field gas by contact with a water solution of monoethanolamine in 21-tray contactors or absorbers installed at the discharge of the first (46 psig.) and second (152 psig.) stages of compression.

The first stage amine absorber reduces the hydrogen sulfide content to approximately 100 grains/100 scf. and the second or final clean-up stage produces a gas which will pass the lead acetate test. The rich amine solution with its load of acid gas is pumped through heat exchangers to the reactivator where the H_2S and CO_2 are stripped from the solution by steam vapors generated in the reboilers. The reboilers are heated with extraction steam from the power plant.

For better heat economy, a "split-flow" amine system is used. About half of the rich amine enters at the top of the packed reactivator and the remainder enters at the mid-point of the tower. A stream of partially stripped or semi-lean solution, withdrawn immediately above the middle of the reactivator, exchanges heat with the feed, and is pumped through coolers to the low pressure absorber, entering the fifteenth tray from the bottom. The completely stripped or lean solution, from the bottom of the reactivator, exchanges heat with the feed and is pumped through a cooler. From the cooler, this stream splits, half entering the high pressure absorber on the nineteenth tray and half entering the low pressure absorber on the eighteenth tray from the bottom. The rich solution from the bottom of the high pressure absorber, having a relatively low acid gas content, is added with the semi-lean solution to the low pressure absorber. A water wash stream from the discharge of the reactivator reflux pump enters the top (21) trap of the low pressure absorber, and a separate water wash stream, stripped of acid gas, enters the top (21) tray of the high pressure absorber, thus minimizing amine loss to the gas streams. Splitting the flow of the rich and lean solution streams in the above manner results in a reduction of reactivation heating and cooling loads.

Overhead vapor from the reactivator is cooled to approximately 115° F.; the condensed water is pumped back to the tower as reflux and the acid gas flows to the sulfur recovery unit.

The process design for the H_2S removal system was developed by the Girdler Corporation.

Sulfur Recovery System

At room temperature the stable crystalline form of sulfur is rhombic, at about 200° F. a solid transition to the monoclinic form occurs, and sulfur melts at approximately 240° F. At the melting point, sulfur is a straw-colored liquid of low viscosity, and as the temperature is increased the viscosity decreases slightly up to a temperature of about 320° F. With further heating, the viscosity rapidly increases from about 40 centipoises at 320° F. to more than 2000 centipoises in the region of 400° F. and then decreases again as the temperature rises above 400° F. Thus, at 320° F. sulfur is easily handled as a liquid in pumps and plant piping, but at 400° F. it is a heavy plastic material.

Design of the Elk Basin sulfur recovery system is based on a modification of the Claus process. Variations of this process have been used for a number of years in Europe but only recently has it been commercially developed in the United States.

In the Elk Basin plant, acid gas from the amine unit, containing approximately 75 percent H_2S and 25 percent CO_2, enters the sulfur recovery unit through a scrubber which removes entrained water (Figure 3). Part of the acid gas from the inlet scrubber is burned with controlled air in a specially designed boiler to produce sulfur dioxide, utilizing the heat of combustion to generate 200 psig. saturated steam. The combustion chamber of the boiler is operated at a pressure sufficiently high (about 3 psig.) to force the combustion products through the remainder of the process without blowers or compressors. Combustion products from the boiler, containing sulfur dioxide, are co-mingled with the unburned portion of the acid gas and pass to the first reactor, which contains a bauxite catalyst. The design inlet temperature of the reactor is 450° F. Reduction of sulfur dioxide and oxidation of hydrogen sulfide occurs over the catalyst, releasing elemental sulfur. The heat of reaction raises the temperature to approximately 740° F., and at reactor exit conditions the sulfur is in the vapor state.

The reactor effluent gases are cooled to approximately 300°F. in a condenser-separator which condenses the sulfur vapor and generates low pressure steam at approximately 35 psig. Reaction is not completely effected in one reactor; therefore, the remaining unreacted gases are reheated above

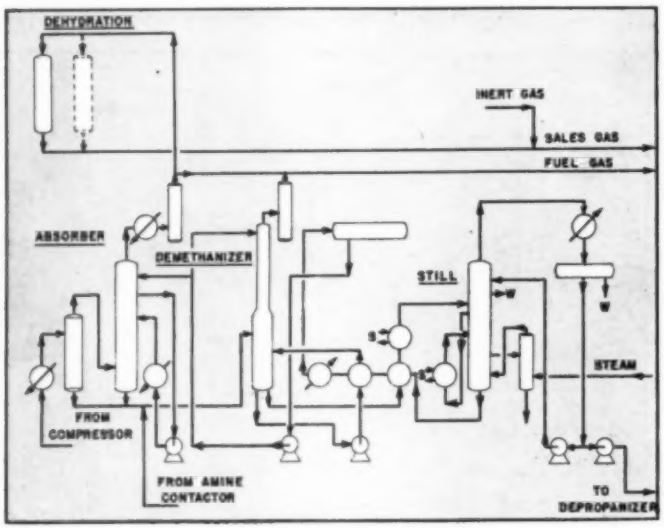


Figure 4. Absorption Distillation, Elk Basin Plant.

the sulfur dewpoint to a temperature of 450°F. in a gas fired line-heater and pass to a second and final reactor where the reaction proceeds substantially to completion. The exit gas from the second reactor flows to a second condenser-separator where the sulfur vapor is condensed at about 300°F. The non-condensed gas, which should contain less than 1 percent H_2S, is exhausted to the atmosphere.

The condensed liquid sulfur flows from the conical bottoms of both condenser-separators to a surge tank and is pumped to storage through a steam jacketed line.

A small auxiliary heater is provided to burn any potential accumulation of carbonaceous materials from the catalyst beds. This unit also serves as a start-up heater.

The important combustion reaction is:

$$H_2S + 3/2\ O_2 = H_2O + SO_2$$

The reaction over the catalyst is:

$$H_2S + SO_2 = 2H_2O + 3\ S$$

The reactors are Lumnite-lined cylindrical vessels, about 16 feet in diameter, with 6-foot catalyst beds. Gas flow is downward through the 4 to 8-mesh bauxite catalyst, with a design space velocity of roughly 250 scf./cf. catalyst per hour. The catalyst bed is supported by a stainless steel grating and wire mesh. To minimize corrosion, an alloy of 18-8 stainless steel is used in the effluent piping from the reactors and for lining the inlet channels of the condenser-separators.

Absorption and Distillation System

The gas from the third stage of the field gas compressors enters the main absorber (Figure 4) where approximately 90 percent of the propane and substantially all heavier hydrocarbon components are extracted by the absorption oil at a pressure of 520 psig. The design oil rate to the absorber is 98 gpm. One intercooler is used to limit the over-all temperature rise of the oil to 20°F., thus reducing the required oil circulation rate.

Rich oil from the absorber, together with treated compressor condensate and drip gasoline, enters the 14th tray of the demethanizer, which is operated at a pressure of 163 psig. Part of the lighter absorbed hydrocarbons flash and rise through the tower, while the remaining rich oil flows down through the 14-tray stripping section of the tower to the reboiler. In the stripping section, vapors from the reboiler remove methane and some ethane from the rich oil. These vapors, along with the flashed vapor from the feed, enter the 24-tray absorption section where the propane loss to the residue gas is controlled by introduction of lean oil to the top tray at a design rate of 40 gpm.

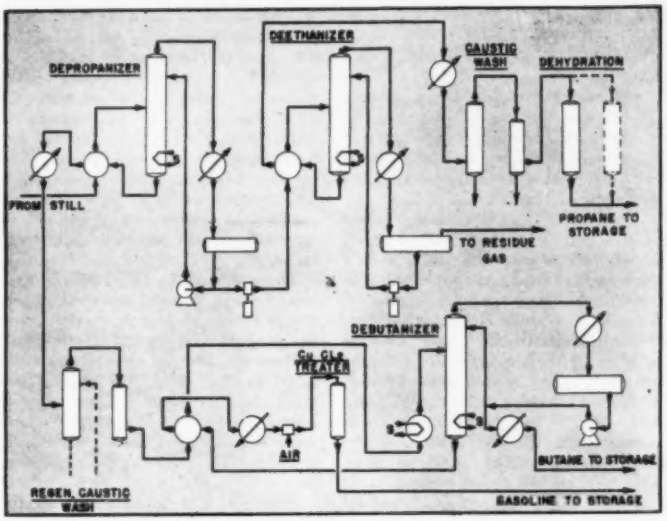


Figure 5. Flow Chart Showing Fractionation-Product Treating at Elk Basin Plant.

The reboiler receives heat by exchange with hot lean oil from the still. The bottoms from the demethanizer, containing a small quantity of ethane, 80 percent of the propane, and essentially all of the butane and heavier components originally contained in the plant feed gas, flow through an exchanger and preheater to the still.

The residue gas from the main absorber (except that quantity used for fuel) is cooled, and dehydrated in a solid desiccant dehydration unit to meet sales gas specifications. Inert gas may be added to control the heating value at 1000 Btu./scf. before delivery for sale at 500 psig. Residue gas from the demethanizer, augmented by the required quantity of residue gas from the main absorber, is used as plant fuel.

The absorbed hydrocarbons are separated from the lean oil by steam stripping at 110 psig. in a 20-tray still. The design stripping steam requirement is 2920 pounds per hour.

Heat is added to the still by a reheater which utilizes 400-pound steam. The stripped lean oil flows through a heat exchanger, the demethanizer reboiler, and coolers to the lean oil surge tank from which pumps return the oil to the main absorber and the demethanizer. The hydrocarbons stripped from the oil in the still are condensed as an overhead product, the end-point being controlled by reflux pumped back to the top tray. Normally, there will be no uncondensed vapors from the still accumulator because of the removal of methane and a large part of the ethane in the demethanizer.

Fractionation System

The unstabilized gasoline from the still accumulator is pumped to the depropanizer (Figure 5) which operates at about 310 psig. The liquid overhead product from the depropanizer, a mixture of ethane and propane, is fractionated in the deethanizer, which operates at 540 psig. to yield commercial propane as a bottom product and ethane-propane vapor overhead. The latter may be recycled through the main absorber to recover the small amount of propane it contains, or sent to the main absorber residue scrubber where it joins the residue gas going to the fuel or sales gas system.

Partially stabilized gasoline from the bottom of the depropanizer is treated with caustic for mercaptan removal and flows to the debutanizer, operating at 110 psig. The overhead from the debutanizer is condensed and the liquid butane product flows to storage through a cooler. The controlled vapor pressure natural gasoline from the bottom of the debutanizer is cooled, sweetened, and pumped to storage.

The depropanizer and debutanizer are so designed that various product specifications may be met. The debutanizer may produce commercially pure butane or an LPG product which may have a maximum vapor pressure of 100 psig. at 100° F. and contain all the recovered butane. It is also pos-

sible to produce a natural gasoline ranging from debutanized to 26-pound RVP gasoline as a bottom product from the debutanizer.

The propane product is treated in a single-stage non-regenerative caustic contactor for removal of any H_2S which may have escaped the amine unit, dehydrated over the bauxite and then delivered to storage.

The high mercaptan sulfur content of the Embar-Tensleep gas makes it impractical to treat the gasoline in a conventional fixed-bed copper chloride treater without a pre-treatment to reduce the mercaptan content, therefore, the combined butane and gasoline product of the depropanizer flows to a packed caustic contactor for removal of lower molecular weight mercaptans and traces of hydrogen sulfide. Spent caustic from the bottom of the contactor is regenerated by steam stripping in a packed tower.

Final sweetening of the natural gasoline produce from the bottom of the debutanizer is accomplished in a fixed bed copper chloride treater.

Drips formed by condensation in the gas collection system during cold weather and at night are pumped into a surge tank in the plant (Figure 1). The drips are pumped from the surge tank through an amine contactor for removal of hydrogen sulfide and then join the rich oil feed to the demethanizer. Lean amine from the hydrogen sulfide removal system is charged to the contactor and rich amine is returned for regeneration.

If crude oil is present, the drips may be charged to the drips still to prevent contamination of the adsorption oil. The drips still operates at 18 psig. and is designed to handle 5000 gallons per day. A gasoline fraction is produced as an overhead product and pumped through the amine contactor to the demethanizer. The heavy bottoms product flows to the heavy oil slop tank.

Inert Gas Generation and Injection System

One of the Elk Basin plant boilers is designed for inert gas generation. It is equipped for close combustion control in order to operate the boiler with a small amount of carbon monoxide and no oxygen in the flue gas. Presence of oxygen is avoided throughout the inert gas system in order to prevent oxidation of the H_2S in the reservoir and possible plugging of the injection wells with elemental sulfur.

The combustion chamber of the boiler is enclosed in a gas-tight steel casing in which cool flue gas is circulated for cooling the boiler setting and preventing air infiltration. With vacuum operation avoided throughout the system in order to prevent air infiltration, the combustion chamber is operated at a positive pressure of 4-6 inches of water. An economizer reduces flue gas outlet temperature to about 400° F. A booster blower delivers the inert gas through coolers to the injection compressors at about 0.5 psig. Water condensed from the flue gas may be recovered and pumped to the cooling tower basin or boiler feedwater.

There are five 4-stage, 1200-hp. (sea level rating), 2-cycle, right-angle, gas-engine-driven injection compressors designed to compress a total of 15 million scf. per day of inert gas from 12.85 to 1525 psia. The design provides that 1 million scf. per day of inert gas be withdrawn from third stage discharge for sales gas dilution to reduce the heating value of the sales gas to 1000 Btu./scf.

The inert gas is delivered by the four stages of compression through interstage coolers and scrubbers to the field injection piping system at 1500 psig. and 165° F. Between the second and third stages (130 psig.) of compression a solid desiccant unit dehydrates the injection gas, thereby eliminating potential corrosion.

Utilities

The design of the steam generation plant is based primarily upon the production of inert gas. In generating the inert gas, the special boiler delivers 52,000 pounds per hour of superheated steam at 440 psig. and 650° F. A conventional boiler provides an additional capacity of 55,000 pounds per hour of steam at the same conditions for stand-by operation, but it normally operates at greatly reduced load for electric power generation. A consideration of steam and power requirements, particularly the large demand for low pressure process steam, indicated that turbo-generation of electric power would be more economical than gas engine generation. Consequently, high pressure superheated steam is used to operate two 1000-kw. generators driven by turbines of the extraction type and delivering 35-psig. process steam at extraction. The turbines exhaust at a condenser pressure of 6 inches of mercury absolute in winter and 25 inches of mercury absolute in summer. Additional 35 pounds process steam is supplied by exhaust steam from turbines driving the 470-h.p. combustion air blower and the 550-h.p. inert gas blower.

Boiler make-up water is supplied by an evaporator. Since water is at a premium, oily condensate from the process area is passed through a chemical oil separator and returned to boiler feed. All return condensate and make-up water is deaerated in a spray type feed water heater.

An 8500-barrel tank is provided for water storage. The induced draft cooling tower is designed to cool 4000 gpm. from 88° to 68° F. Cooling tower make-up water from the Clark's Fork River is treated with sulfuric acid and stabilized with a corrosion inhibitor.

The two turbo-generators develop electric power at 2400 volts for the plant and the field. Power is distributed to central locations in the plant at 2400 volts and then reduced to 440 and 110 volts. Power from the generators, supplemented by outside facilities, is transformed to 7200 volts for transmission to the oil field.

A 50-psig. plant fuel gas system utilizing residue gas from the demethanizer and absorber provides fuel gas for the compressors and boilers. Plant fuel gas is not dehydrated.

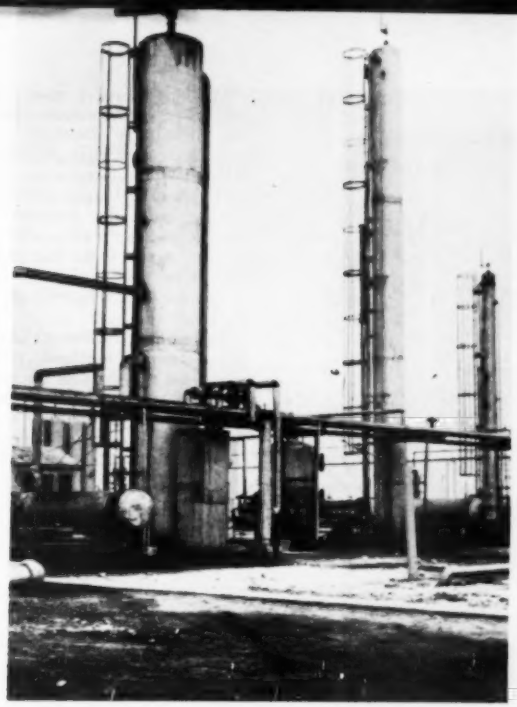
Storage Facilities

Approximately ten days storage for each of the liquid products is provided by 10-foot x 60-foot horizontal cylindrical tanks adjacent to the process area. Loading pumps transfer the liquid products to a two-spot truck loading rack. A suitable ticket house is provided. Two 500-barrel vertical tanks provide storage for absorption oil and heavy slop oil. A pump is installed to transfer absorption oil to and from the storage tank. Also, a re-run pump is provided to pump any off-specification product back to the distillation system.

As to sulfur, a belt conveyor was considered for atmospheric cooling and solidification, the sulfur being broken off in flakes at the end of the belt. The efficiency of this technique is attractive for long-time operation but possibility of a market for liquid sulfur in the near future has resulted in selection of the simplest method for initial operations.

Molten sulfur from the sulfur extraction unit is delivered through a steam jacketed line to the sulfur storage area. There, the sulfur is discharged into a temporary sheet-metal vat where it solidifies by atmospheric cooling. The sheet-metal walls of the vat are raised as the sulfur hardens. When desired, the sheet-metal is removed and the solid cake of sulfur is blasted, loaded into trucks and hauled to a rail siding at Powell.

Construction of the plant was started in September, 1947 and initial operations began in March, 1949. Stone and Webster Engineering Corporation was contractor.



Chemical circulation cleaning of processing towers like those above helps circumvent costly manual and mechanical cleaning procedures. No "cutting in" or dismantling necessary in cleaning by circulation of chemical detergents.

Chemical Circulation Methods In Cleaning and Descaling Petroleum Processing Equipment

VINCENT BOWES
Manager, Oakite Petroleum Service Division,
Oakite Products, Inc., New York

EVERY refinery superintendent is interested in performing necessary cleaning and related operations with a minimum loss of productive time. It is for this reason that cleaning by means of the circulation of specialized chemical solutions is creating tremendous interest throughout the petroleum industry.

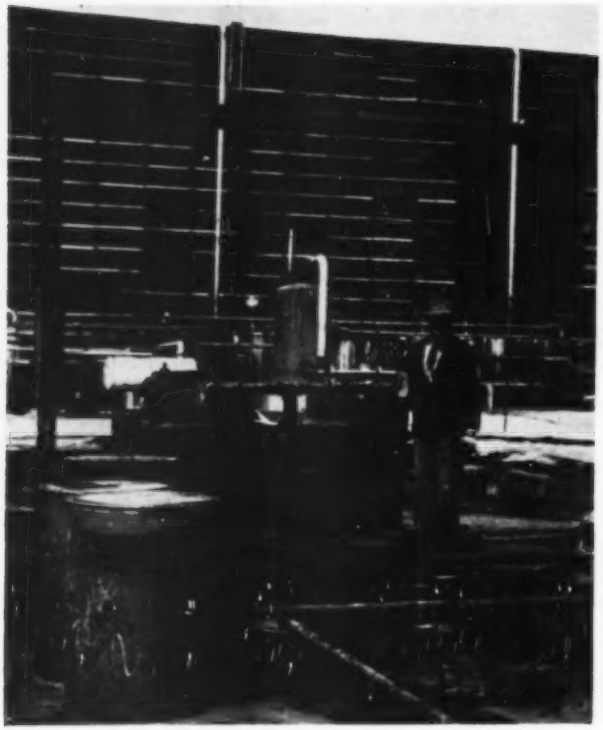
In addition, circulation cleaning and descaling of towers, stills, tanks, heat exchangers and lines offers a strong appeal to refinery finance executives because this method circumvents costly manual and mechanical methods of cleaning-descaling.

In this program of circulation-cleaning, technical service representatives of cleaning materials manufacturers help to plan the cleaning-descaling procedure as well as to help select the proper chemical material for use in circulation. The necessary quantity of the selected alkaline, acidic, or solvent-type material is then delivered to the refinery. The refinery carries on from there and completes the cleaning procedure from that point. It provides and installs the pumps, motors, tanks, lines, and other equipment required for the job. The refinery also provides the maintenance personnel to perform what is now a relatively simple task of carrying out the nearly automatic cleaning-by-circulation procedure as planned by the service representative.

This "on-line" cleaning and descaling of refinery processing equipment offers these important advantages to refineries interested in cutting costs and out-of-service time for equipment:

1) *Avoids dismantling* of equipment which often leads to equipment damage and usually involves time-wasting work.
2) Produces the *thorough cleaning* that often is not possible when attempting to reach "hidden" surfaces with cleaning tools.
3) Provides more *uniform cleaning*, thus lessening the chances of small residue particles forming nuclei for further accumulations.
4) *Minimizes abrading*, loss of important dimensions which often occurs in mechanical cleaning.
5) *Leaves metal surfaces smooth* whereas mechanical cleaning meth-

***PROCESS** equipment works best when it is clean. The degree of cleanness necessary for satisfactory performance varies with the type of equipment and the service. A foreign deposit on a bubble tray which might have little effect on the tray's hydraulic performance could, if occurring instead on a heat exchanger surface, render that unit almost completely ineffective. On the other hand, a heavier accumulation of deposited materials or rubbish on the bubble tray most assuredly will lower the capacity and possibly the efficiency of the fractionator. Lowest utility costs are had with perfectly clean equipment. In practical plant operation the optimum state is reached when the cost of utilities is balanced against clean-out expenses, maintenance, operating costs, and product realizations, to give the best over-all economics. Obviously, equipment or procedures that lessen downtime for clean-out, or lower the cost of such cleaning, are of real importance to plant operators. Accordingly, this article on chemical cleaning method is recommended as a possible source of clues to improvements in plant operations.*



Lines returning circulated, recovered cleaning solution from towers to drums where tower-clogging deposits settle out. Chemical cleaning solution is then re-used.

ods might often score and pit surfaces, thus creating ready-made lodging areas for fouling deposits.

6) *Saves* cleaning *time*, cleaning *materials*, cleaning *costs*.

Selection of Cleaning Material

Visual, and in many cases, chemical examination of deposits that have formed on processing equipment surfaces will help to determine the selection of the proper material for use in circulation cleaning. The characteristics of these fouling substances, their thickness and adhesive properties, will also go a long way toward determining the temperature and pressure at which circulation-cleaning is to be performed. The extensive experience of the cleaning material manufacturers' service representative is often invaluable in selecting the material and method for best results.

Repeated tests should be made to determine the solubility of particular deposits in various chemical solutions, until the proper compound is selected. This experimental testing calls for considerable skill and experience. While deposits vary from processing cycle to processing cycle and from one section of the country to the other, basic experience in performing a wide variety of similar tests on refinery equipment is both important and extremely helpful.

For test purposes, it is well to select sample deposits from different points in the processing system. For example, types of deposits to be removed from tubes of heat exchangers will often depend on the location of the exchanger equipment in the processing system, the temperature at which the deposits have built up and many other factors.

Breaking the Oil Binder

Experience in circulation-cleaning indicates that if the oil binder which often holds tower-fouling deposits to the metal surface can be more quickly loosened, the job of cleaning will be greatly expedited. For this primary binder-breaking task, a fast-emulsifying material is recommended. Such a chemical material will solubilize deposits like waxes, resinous products, entrained crude and certain carbon formations. Furthermore it prepares these deposits for complete removal by rinsing.

In many cases, a rinse with boiling water *before* circulation of the fast-emulsifying chemical compound is recommended. High-pressure rinsing following the circulation is always recommended. Under all conditions, rinsing away the detergent-loosened deposits makes for successful cleaning. Important, too, is the fact that rinsing should be continued until the water drains out in a relatively clear condition.

To test the effectiveness of the circulation-cleaning method, fresh water should be run through the tower after the final rinse and the pressure reading noted. If circulation cleaning has been thorough, this pressure indication should be normal or very close to it.

Setting Up the Program

After the proper cleaning material has been selected, it is a good policy to plan a regular cleaning schedule. Heat-transfer surveys may be initiated and carefully performed in conjunction with the helpful guidance of a technical service representative of an industrial cleaning material manufacturer. Such a survey will help to determine which units in the system require cleaning more frequently than others. Once standardized, the cleaning-descaling program will prove to be a real money-saver, because circulation time will be considerably reduced as will the amount of chemical material used for circulation-cleaning procedures.

Planning periodic cleaning-descaling procedures also enables the maintenance department to schedule ahead in the use of men and equipment. It makes it possible and economical to fabricate special equipment which will then be used repeatedly for circulation-cleaning.

Hard-Water Scale Conditions

Where hard-water conditions cause the formations adhering to equipment as a result of processing salty crudes, for example, a specialized acidic material should be selected for the circulation-cleaning method. Such a material will need to be carefully inhibited, balanced for safe and thorough dissolution of lime scale, oxides and other soluble-in-acid deposits. Determining the solution concentration, selecting the proper pumping equipment, and performing careful, intermittent circulation of the acidic solution all require experience and good judgment. Successful experience of service representatives who have performed this work should prove invaluable.

Gas Absorber Towers

Cleaning the absorber tower and associated heat exchanger and still units of a natural gas recycling plant may be effectively carried out by the

Refinery personnel preparing chemical solution before pumping it to tower for cleaning by circulation. Pipe inlets from drums, right, return the recovered, settled-out detergent solution for economical cleaning.

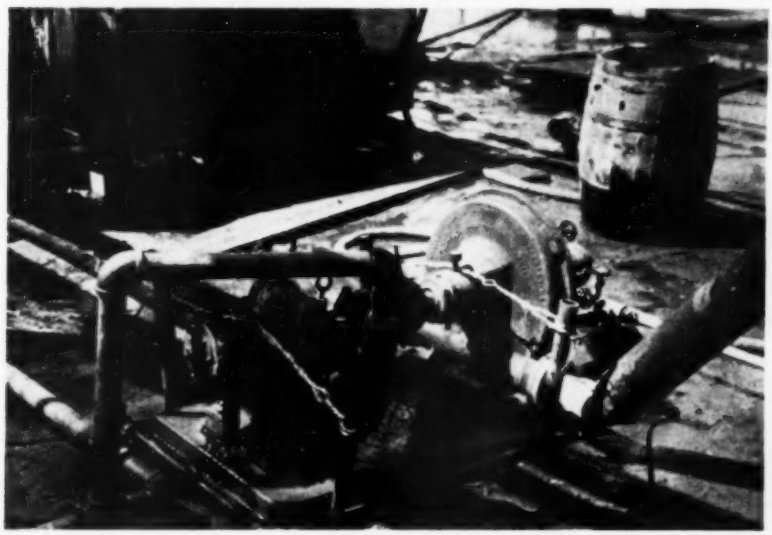
circulation of a fast-acting, free-rinsing alkaline cleaner. This type of material, if properly selected and circulated, will thoroughly break down wax residues, grease, oil binders and carbon deposits which so often retard tower output. Loosened deposits are then easily, thoroughly rinsed off; and surfaces are left clean and unharmed.

In the cleaning of towers by the circulation method, it has often been found advisable, for maximum speed and economy, to precede circulation of an alkaline-type cleaning solution with a period of soaking. In this presoak a specialized solvent-type cleaning solution is used to soften the carbon deposits. This makes cleaning by the circulation of a recommended alkaline-type solution, as stated above, easier and faster. The liquid solvent material may be used at full strength or diluted with kerosine or other distillate, as required.

Hints on Pumping and Pressure

At times, trays, down spouts and caps of towers are so choked with fouling deposits that the pump used for circulating the cleaning-solution is forced to operate under tremendous pressure. To overcome this condition, it is often recommended that a second pump of the same capacity should be hooked into the system and operated with the first pump for a short period. According to accepted procedure, both pumps should then be shut down. This will allow the specialized chemical cleaning solution to penetrate through the deposits in the tower and open a path for the flow of solution. Once the solution forces its way through the accumulations on trays and caps, the pressure within the tower will be reduced. The second pump may then be taken off the line.

Tube bundles of heat exchangers



Pumping detergent solution from mixing tank to tower for chemical circulation cleaning process. Refinery personnel easily controls nearly automatic procedure.

Tank where chemical cleaning solution is mixed, showing water feed and steam-heating lines for preparing solution before circulating it through towers.

may be cleaned as part of the entire processing system, or by isolating the exchangers from the system and circulating a recommended cleaning or descaling solution, or by removing the bundles and immersing them in a solution of an efficient chemical compound. Experience with all these methods shows that the most efficient and effective procedure here is determined by the particular equipment setup, production schedules, the kind and amount of deposit to be removed and other factors. Here again the expert suggestions and recommendations of trained representatives of specialized cleaning material manufacturers can be of inestimable help.

A mobile installation, including pump, motor and solution-holding tank mounted on wheels, is an effective time-saver in refinery work. Such a unit may be readily available for cleaning and rinsing work at any point in the refinery. For economical maintenance of this equipment and for most effective cleaning, it is usually recommended that an acid-proof pump is installed in the mobile set-up if acid-type solutions are to be circulated through the heat exchangers.

In some cases, where banks of heat exchangers are cleaned more often than other units in the system, it may be advisable to install a permanent solution tank adjacent to the exchangers and run permanent lines to the sides of exchangers. One Southwestern refinery with hot solvent exchangers of butadiene extraction units found that by installing permanent cleaning equipment the cost of cleaning was reduced by some $25,000 per year.

Circulation cleaning and descaling has proved and is continuing to prove superior in speed and economy as a maintenance practice. However, where conditions do not warrant the use of circulation methods, the soak-immersion procedure is recommended for cleaning and descaling heat exchanger bundles. Time involved is the one big consideration in the choice of this method. Yet this method is still more efficient and economical than mechanical methods of cleaning or descaling such as buffing with air-operated equipment, sandblasting, sawing and rodding.

Cleaning Shell Side of Exchangers

Various types of deposits on the shell side of heat exchanger bundles often produce costly heat-transfer loss. For most effective removal of oil films, carbon coatings, paraffin distillate and waxy residues from the shell side of bundles, soak-immersion in a recommended cleaning solution is suggested. If water is circulated on the shell side of bundles and scale deposits accumulate, immersion of bundles in a solution of an inhibited acid-type compound is recommended. Effective practice suggests that hot-water pressure rinsing should always follow, then alkaline neutralizing and re-rinsing.

Heat exchanger bundles in this processing cycle are known to take on a build-up of particularly tenacious, carbon-like deposits. On bundles where slurry is in contact with the tube side, the top of the deposit is usually soft, but underneath there is often found a hard scale. Although uniformly thorough and fast results cannot be predicted for this work, considerable success has been obtained with a specialized, acid-type compound which possesses effective wetting and penetrating properties for effective cleaning. Circulation or soak-immersion method may be used.

On the shell side, where the feed is run at somewhat lower temperatures, a specially designed alkaline-type cleaning solution may be circulated for softening and loosening deposits.

Hot solvent exchangers of butadiene extract cycles often build thin, hard carbon deposits on the shell side and clay-like layers on the water side. Both types of deposits respond to solutions of the specialized acid-type material referred to above. If bundles have not been cleaned for long periods, it may be necessary to disassemble them and soak them in a hot, fast-acting solution of the same chemical compound.

Compared with the old method of manual cleaning after disassembling, the procedure outlined above will produce a substantial saving of time and will restore equipment to normal efficiency and capacity.

Summary

Circulation cleaning procedures offer an excellent opportunity to cut costs and reduce equipment out-of-service time. However, they should be planned and executed under the supervision of trained, experienced specialists in refinery cleaning programs. Before launching such a program, it is advisable to contact one of the representatives of a manufacturer of specialized industrial cleaning materials who is experienced in petroleum maintenance work. Such a representative is undoubtedly located in your area, if you are doing business in continental United States or Canada. Usually, the services of such specialists are free and without obligation.

Lubricating Oil Additives

V. A. KALICHEVSKY
Consulting Chemical Engineer,
Magnolia Petroleum Company,
Beaumont, Texas

PART 5. Dyes

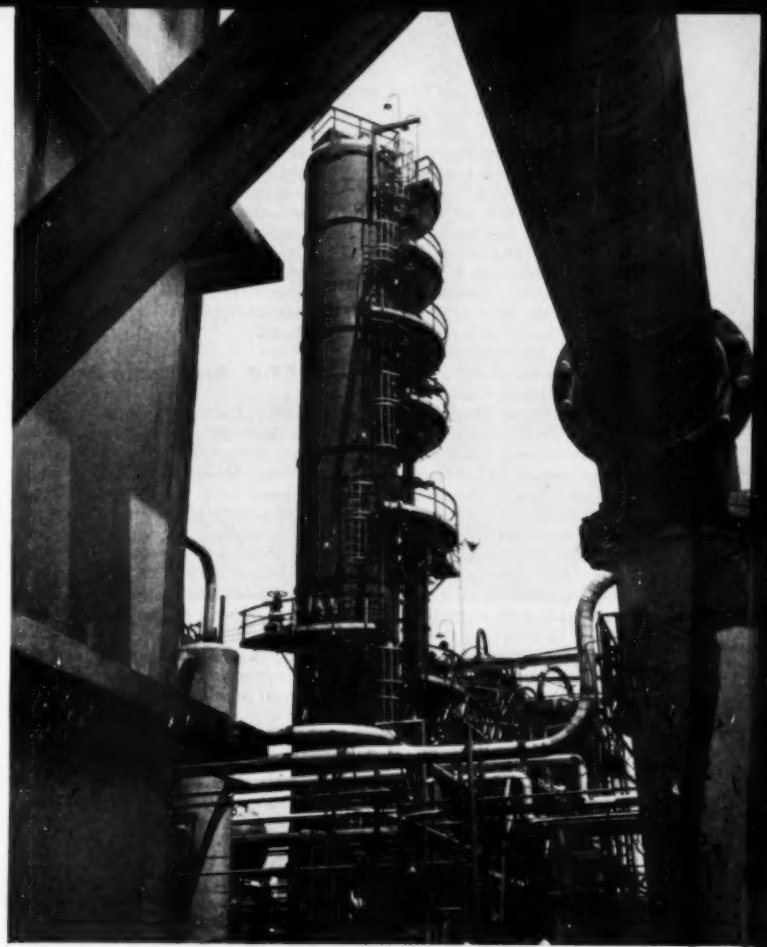
WHEN lubricating oils first appeared on the market there were no significant tests available for evaluating their quality. The customer made his own evaluation by carefully observing color and general appearance, and then by rubbing a few drops of the oil between his fingers in order to approximate its viscosity or "body." Although these inspections were very crude they served the purpose. The existing machinery was not oversensitive to considerable variation in viscosity of the lubricant while the color of the oil was fairly indicative of the crude source and the degree of refining. Notwithstanding the development of exact testing procedures and different methods for estimating performance characteristics of oils, thier color still has much appeal to the customer who is unfamiliar with the present ramifications of petroleum technology.

Oils may be inspected in transmitted or reflected light. The light colored oils are usually examined by the first method while the darker colored ones are examined by the second method. In the first instance, suspended particles of sludge or dirt that may be present in the used oil become clearly visible while in the second instance they are concealed. Therefore, to the casual observer, a light colored oil containing relatively small quantities of suspended carbonaceous materials may appear to be much more contaminated than a dark colored fluorescent oil full of impurities but inspected in reflected light.

Solvent refined oils are generally of considerably lighter color than the conventionally refined ones. They are almost free of fluorescent substances and are quite transparent. All suspended matter that may be present in even slightly used oils is clearly visible and the customer may suspect that the oil is unstable while actually its resistance to oxidation is high. Furthermore, some of the additives, particularly those of the detergent type, may darken the oil considerably and give it a rather poor appearance.

Fluorescent improvers are helpful in overcoming a certain amount of sales resistance that such products may create. They add nothing to oil quality and theoretically may even detract from it although the quantities employed are too small to affect the important properties of lubricants. Fluorescent improvers are also used to conceal the base of the crude oil from which the lubricants are made. For a number of years the greenish fluorescence was associated in the minds of the public with premium grade oils. This fluorescence had considerable sales appeal, and oils from other than certain types of crude oils were difficult to market even though they were of superior quality. However, the fluorescence of such oil could also be improved by employing special treating procedures such as high temperature contacting with clay.

Considering that a fluorescence improver has no deleterious effect on oil quality one of its main requirements is stability in service. They are not equal



New Fractionating Tower being Installed by Socony-Vacuum Oil Company, Inc., at its East St. Louis, Ill., Refinery.

FLUORESCENT improvers represented by various dyes often derived from petroleum sources are used to appeal to the taste of customers although they do not improve and may even have an unfavorable effect on oil quality. Anti-foam agents of which silicon compounds are most prominent grew in importance with the development of additive oils which often have the tendency to foam. Rust preventatives are slightly polar compounds and are employed to impart to the oil the property of protecting metallic surfaces as far as possible from atmospheric corrosion.

A list of patents covering various types of these additive agents is attached.

The importance of systematic research in the field of additives is stressed in favor of haphazard investigations.

in this respect and each one must be tested thoroughly before it is incorporated in the commercial product. Substances specifically recommended for petroleum lubricants are listed in Table 16. It may be noted that a large proportion of them are prepared from petroleum or from coal tar and are of rather indefinite composition. In general, however, their use is somewhat limited as the public is becoming aware of the fact that the color of the oil has no relation to its performance.

The color of lubricating oils is generally maintained as closely as possible to that of the natural product. On the contrary, for many years gasolines have been dyed every color of the rainbow. This was done to indicate the presence of poisonous substances, i.e., tetraethyl lead, and to differentiate between the brands manufactured by individual concerns. Soon after the various coloring schemes were introduced, they found wide acceptance among the public. Similar attempts have been made with respect to lubricants but to date only a few isolated instances are on record and it is doubtful that the practice will become general.

Occasionally the manufacturer is interested to know whether his product is adulterated. This can be determined by adding to the oil small quantities of certain substances often referred to as identifiers. Phenolphthalein, Oil Brown M, and methyl red, which do not affect the appearance of the oil but permit its identification after performing a few simple tests, were proposed for this purpose. Other similar materials include umbeliferone, phenol, furfural, etc.

PART 6. Anti-Foam Agents

OILS which do not contain additives do not have the tendency to foam. However, in the presence of some additives a considerable amount of air and gas is entrapped while the oil is circulated and some time is required to separate them by settling. As a result, such oils foam which interferes with the smooth operation of the engine.

Robinson[1] demonstrated that in a straight mineral oil the rate of rise of the air bubbles is directly proportional to the square of the apparent diameter and inversely proportional to the viscosity of the oil which is in conformity with Stoke's law. With oils containing additives an absnormally slow rise of air bubbles was observed, and the rate of rise decreased with the length of the path the bubbles had to travel. This condition is remedied by the use of anti-foam agents.

Various anti-foam agents have been suggested as shown by the data presented in Table 17. The one most widely recognized is a silicone compound known under the trade name of Dow Corning Fluid 200. The efficiency of this substance is surprising as only a few thousandths of one percent added to the oil completely eliminates formation of foam, both in the presence and absence of additives. Trautman finds that five parts of such silicones per million parts of oil completely suppresses foaming by promoting coalescence of air bubbles.[2] The small amount of this anti-foam agent required to achieve the desired result has no apparent effect on oil properties other than reduction of foaming characteristics. It is of interest that silicones are very resistant to heat and their efficiency is not destroyed under conditions encountered in service. The anti-foam agents are very often added to

TABLE 16
Fluorescence Improvers

Substance	U.S. Patent	Date	Inventor
Anthraquinone dyes	2,426,577	8-26-47	Sealera, M. and Hardy, W. B.
Benzanthrone or dibenzopyrenequinone.	2,305,469	6-25-40	Hopf, H. and Schoenherr, H.
Coal-tar distillates	1,839,012	12-29-31	Black, J. C., Rial, W. D. and McConnell, J. R.
Coal-tar residue heated with unsaturated hydrocarbons.	2,106,707	2- 1-38	Smith, L. B., Funsten, S. R. and Field, H. W.
Coal-tar pitch heated with sodium hydroxide.	2,085,759	7- 6-37	Laskaris, L.
Condensation product of liquid sulfurdioxide extracts and anthracene.	1,988,753	1-22-35	Shaffer, S. A. and Fasce, E. V.
Condensation products of monoolefins and polynuclear organic substances.	2,028,472 2,071,521	1-21-36 2-23-37	Rabe, H. Hartmen, H. and Rabe, H.
Cracked liquid sulfur dioxide extracts	2,295,035	9- 8-42	Gilbert, G. R. and Peer, A. A.
Cracked petroleum solvent extracts	2,150,363	3-14-39	Dawson, O. H.
Cracked refined residua	1,973,118-9 2,051,255 2,040,057	9-11-34 8-18-36 5- 5-36	Spencer, C. F. Harger, D. K. Manley, R. E. and Gross, H. H.
Dyes from cracked refined residua	1,974,778	9-25-34	Lang, F. R.
Esters condensed with aromatic compounds.[1]	2,406,549	8-27-46	Lieber, E.
Extracts from coal-tar residua	1,839,012	12-29-31	Black, J. C., Rial, W. D. and McConnell, J. R.
	1,842,856	1-26-32	Black, J. C., Rial, W. D. and McConnell, J. R.
Heavy condensate from cracked hydrocarbon gases.	2,097,245	10-25-37	Towne, C. C., and Carlson, E. W.
	2,119,067	5-31-38	Carlson, E. W.
Hydrogenated condensation products of cracked distillates and naphthalene.	2,111,126	3-15-38	Rabe, H.
Light naphtha heated with phosphorus pentoxide.	2,232,968	2-25-41	Robertson, A. E.
Oil coloring portion of pitch from cracked hydrocarbon oil.	2,017,529	10-15-35	Clulow, F. S.
Perylene condensation product	2,191,114	2-20-40	Neresheimer, H. and Vilsmeier, A.
Petroleum resin-halogenated hydrocarbon condensation product.	2,300,391	11- 3-42	Agruss, M. S., Schindler, H. and Ayers, G. W. Jr
Polymerized liquid sulfur dioxide extracts.	2,010,606	8- 6-35	Moser, F. H.
Polymers from spent clay	1,899,608	8- 2-32	Miller, C. C.
Reaction products of aluminum chloride and petroleum oils.	1,868,473	7-19-32	Smith, H. G.
Reextracted liquid sulfur dioxide extracts.	1,944,851 2,058,696	1-23-34 10-27-36	Smith, H. G. Lazar, A. and Evans, J. M.
Residue from vacuum distillation of a desulphalted product obtained from destructive hydrogenation of coal	2,104,097	1- 4-38	Pier, M., Hirschberger, W. and Lemme, H.
Water-insoluble soap of a high fatty acid heated with acridine, rhodamine, eosine or eurbodine dyes.	2,147,713	2-21-39	Orelup, J. W.

[1] Recommended also as pour point depressants.

TABLE 17
Anti-Foam Agents

Substance	U.S. Patent	Date	Inventor
Acetyl or butyl esters of sulfonated ricinoleic acid.	2,390,491-2	12-11-45	Bennett, H. T. and Marshall, J. R.
Alkyl alkylene diphosphates	2,411,671	11-26-46	Smith, H. G. and Cantrell, T. L.
Aniline and similar salts of isoamyl cetyl phosphate.	2,397,377-81	3-26-46	Smith, H. G. and Cantrell, T. L.
Aniline and sulfonated castor oil reaction product.	2,355,255	8- 8-44	Zimmer, J. C. and Seitz, W.
Benzoyl acetone, methyl salicylate and similar substances.	2,430,857	11-18-47	Borsoff, V. N. and Clayton, J. O.
Dimethylsilicone, diethyl silicate and similar substances.	2,375,097	5- 1-45	Larsen, R. G. and Diamond, H.
Ethyl acetoacetate, propylene glycol, triethanolamine, dimethylglyoxime and similar substances.	2,430,858	11-18-47	Borsoff, V. N. and Clayton, J. O.
Glyceryl monostrearate	2,407,954	9- 7-46	Fenske, M. R. and Cummings, G. H.
Highly fluorinated aliphatic and cyclic aliphatic hydrocarbons.	2,394,596	2-12-46	Davis, G. H. B. and Zimmer, J. C.
Hydrogen peroxide and triamylamine reaction product with or without blown lard oil.	2,230,022	1-28-41	Altamura, M. S., Berger, H. G. and Badertscher, D. E.
Nitro and amino alkanols	2,402,487	6-18-46	Batchelder, A. H. and Rollins, F. S. Jr.
Organo-metallic compounds	2,294,145	9-25-42	Winning, C., van Voorhies, R. L. and McNab, J. G.
Phosphatide materials of animal origin and an animal fat-like material.	2,244,416	6- 3-41	Ashburn, H. V. and Alsop, W. G.
Potassium oleate	2,377,654	6- 5-45	Smith, H. G.
Tricaprylyl monothiophosphate or tri-2-ethylhexyl monothiophosphate.	2,353,587	7-11-44	Rill, C. N.

commercial detergents such as Santolube 303-A, Santolube 570-X-4, Paranox 62, Paranox 105 and others. This is done in order to minimize the number of additives handled in refining operations.

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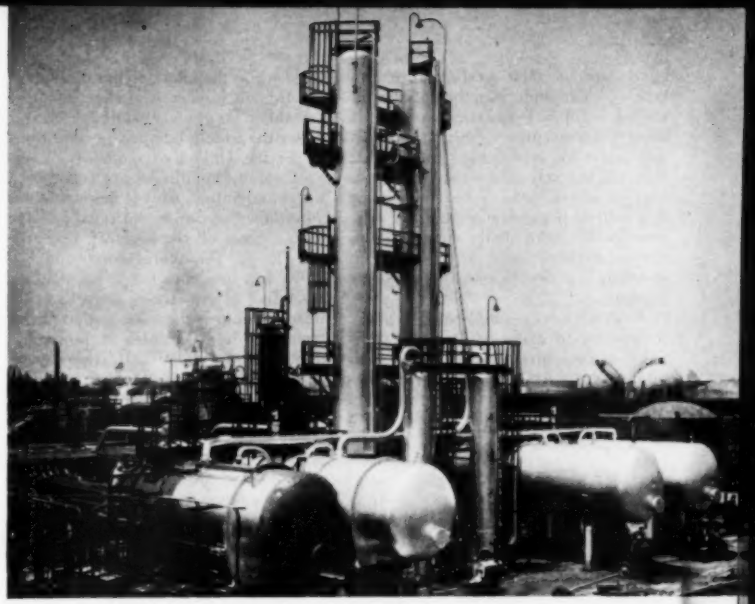
[1] Robinson, J. V., J. Phys. Colloid Chem. **51**, 431-7 (1947).
[2] Trautman, C. E., Lubricating Eng. **2**, No. 4 143-6 (1946).

PART 7. Rust Preventatives

SOME oils such as special grades of turbine oils, are expected to protect the engine from corrosion. Similar requirements may be imposed on products like hydraulic oils or extreme pressure lubricants. When the equipment is not in use a very thin film of oil should remain on the surface of metals preventing direct contact with the atmosphere, while in service the same effect is expected on engine parts which are only in very occasional contact with the circulating oil. Equilibrium surface tensions of water and oil and their interfacial tension are claimed to be major factors responsible for satisfactory performance of rust preventatives.[1] However, rusting does not occur in the absence of moisture and the importance of ventilation cannot be overemphasized even when rust preventatives are used.

Sellei-Beretvas[2] and Sellei and Lieber[3] distinguish three phases in the development of these types of oils. The first phase coincides with the use of rust preventatives in mineral oils serving only as convenient vehicles for the additives and not necessarily refined to bring out their other desirable characteristics. The second or present phase of development stresses the importance of employing oils meeting the specifications for special high quality lubricants. The third or future phase is expected to involve the use of rust preventatives in all oils coming in contact with metals. The importance of adjusting the quantity of additives is emphasized because excessive amounts of rust preventatives may be harmful to the performance characteristics of oils.

Rust preventatives acquired practical importance not more than a decade ago although they were discovered some years previous. They are slightly polar compounds which is necessary to insure adhesion to metallic surfaces. However, they should have no chemical action on metals as otherwise they will defeat the primary purpose for their use. Ethers, esters, nitrogen and phosphorus compounds, metallic soaps, organic acids and similar materials were suggested, as shown in Table 18, shown on the following page. The list includes slushing compounds and related products employed for protecting metal objects in storage. Hamilton and Keyser[4] find that long chain substituted polycarboxylic acids and esters are particularly suitable for commercial use.



Solutizer Unit at Socony-Vacuum Oil Company's East St. Louis, Ill., plant.

Kuebler[5] showed that addition to fresh oils of some of the used oils, fatty acids, cutting oils or polar compounds imparts the anti-rust characteristics but at the same time has a deleterious effect on oil quality. This accentuates the importance of carefully testing oils containing anti-rust preventatives before releasing them to the trade.

Santolube 303-A, described under detergents, is an example of a commercial additive used in rust-proofing formulations. Paranox 447-A is a rust preventative and oxidation inhibitor. It is an alkyl-phenol type anti-oxidant and contains 0.20-0.25 percent zinc. It is a pale non-viscous liquid of 290° F. flash point, 59 Saybolt Universal viscosity at 100° F., 0° F. pour test and weighs 7.31 pounds per gallon. It is used in quantities of about 2.4 percent in turbine or other industrial circulating oils operating in the presence of water.

Ionex is a polar organic liquid used in amounts of about one per cent by volume in turbine and similar oils. It has a 29° API gravity, 15° F. pour point, 165-185 Saybolt Universal viscosity at 100° F., 385° F. flash point and 9-10 neutralization number.

Plexol 410 has 1.02 specific gravity, 782 Saybolt Universal viscosity at 100° F. and 405° F. flash point and is another example of a rust preventative employed in mineral oils and greases. It is used in quantities up to one percent by volume. Plexols 305 and 316 are recommended for improving the efficiency of anti-rust agents.

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[2] Sellei-Beretvas, H., Lubrication Engineering, Aug. 1945.
[3] Sellei, H. and Lieber, E., Lubrication Engineering, Sept. 1947, 16-23, 42; Corrosion and Material Protection, May, 1946.
[4] Hamilton, L. A. and Keyser, P. V., Jr., Nat'l Petroleum News, Mar. 6, 1946, R228.
[5] Kuebler, W. P., Mech. Eng. **68**, 889-93 (1946).

PART 8. Present Status

THE variety and the absolute number of additives suggested for improving service characteristics of lubricating oils are great, and it is not a simple task to make proper selections and to adjust the quantities of individual components in a mixture in order to insure satisfactory performance. Unfortunately, little systematic work has been done on the subject in the past although there is every reason to believe that the problem is by no means as complex as it appears on the surface, and that it can be solved by careful experimentation.

Up to now major efforts are still directed not toward a methodical investigation of the principles involved in the action of additives, but to finding multitudes of new compounds in the hope that some of them may possess magic properties and thus solve the existing worries. This search reminds one of the alchemists who tried to discover the elixir of life or a universal solvent. A similar situation existed not so many years ago with the solvent refining processes. Absence of compar-

ative data on their performance and lack of clear understanding of the involved solubility phenomena created many misconceptions which are clarified only by systematic studies that removed the veil of mystery surrounding for a considerable length of time this field of petroleum technology. The same will undoubtedly happen with the additives and will result in speeding up development of superior products.

Nature is not as complicated as many people try to make it. The real difficulty encountered in the work with additives is separation of a large number of conflicting variables affecting performance of oils in the field which is by no means easy. Laboratory tests may be able to solve certain problems provided they cover a range of working conditions and not individual points which cannot be correlated with the field data obtained under different circumstances. Experimental engine runs covering a more or less arbitrarily selected sets of variables are open to the same criticism. In such runs the number of variables is greatly multiplied while the effect of the individual variables is hidden. The effect of these variables is not the same, however, under the widely fluctuating conditions of service. Only too frequently "average" service conditions are substituted for actual values. This is merely a tacit admittance of our inability to analyze the problem on the basis of available knowledge. The average of 0 and 100 is 50, but this does not mean that the net effect of two trains moving at 50 miles an hour is the same as that of one train moving 100 miles an hour, and another at a standstill. Moreover, complaints seldom arise from the engines operating within more or less standard conditions of service but from a relatively small percentage of those operated at extreme ranges. It is not unusual that in attempting to correct such a situation other engines are thrown out of balance with the result that more and not less complaints are received from other customers which were formerly satisfied with the product.

The cause of many difficulties might be attributed to the present status of commercial research, particularly within the petroleum industry. Some 100 or more years back, almost any experiment led to new discoveries because the whole field of technical knowledge was wide open. As the time went by the probability of finding something new and startling began to fall off rapidly and the pay-off on haphazard and disconnected experiments began to approach a vanishing point. At the present time steady returns may be expected, not from superficially tested wild ideas, but from methodical investigation of the already known phenomena. This does not mean that wild goose-chasing should be abandoned entirely, but kept within reasonable limits by controlling the gambling spirit in solution of commercial problems. In this respect the chemical industry is often ahead of the petroleum industry because of their early realization of these changing conditions of research. It is to be hoped that future work will be devoted to a much greater extent than it is now to the study of fundamentals which would clarify our present dim understanding of the functions of various classes of additives.

TABLE 18
Rust Preventatives

Substance	U.S. Patent	Date	Inventor
Acidic compounds in alkaline sludges from treating cracked gasoline	2,398,120	4- 9-46	Schindler, H.
	2,405,906	8-13-46	Schindler, H.
Acid phosphate esters of alkylated phenols reacted with amines.	2,371,853-4	3-20-45	Smith, H. G. and Cantrell, T. L.
Acylated amines	2,426,358	8-26-47	Blair, C. M. Jr.
Alcoholic extract of brown lard oil	2,395,093	2-19-46	Bishop, J. H.
Alkali peroxides reacted with an alcohol.	2,054,721	9-15-36	Clementson, C. M.
Alkylamine and cycloalkylamine salts of acid phosphate diesters.	2,403,762-5	7- 9-46	Smith, H. G. and Cantrell, T. L.
Alkylammonium naphthenates	2,430,951	11-18-47	Rouault, G. F.
Alkylated phenols reacted with formaldehyde and amines.	2,363,134	11-21-44	McCleary, R. F.
Alkyl maleic acid derivatives	2,279,688	4-14-42	Larsen, R. G.
Alkyl stearate or naphthenate	2,186,018	1- 9-40	Griesinger, W. K.
Aluminum stearate, butyl stearate and wool fat.	2,374,565	4-24-45	Roden, H.
Aluminum triphthalyl alkyl amide	2,378,443	6-19-45	Smith, H. G., Cantrell, T. L. and Peters, J. G.
Amidoximes	2,387,323	10-23-45	Gaynor, J. W.
Amines and heat treated castor oil	2,283,931	5-26-42	Irwin, E. R.
Amino derivatives of oxidized petrolatum.	2,378,890	6-19-45	Burwell, A. W. and Camelford, J. A.
Amino salt of an organic phosphate	2,371,555	3-20-45	Smith, H. G. and Cantrell, T. L.
Amino salts of naphthenic, benzoic or salicylic acids.	2,401,993	6-11-46	Wasson, J. L. and Duncan, G. W.
Aryl-alkyl ketones	2,075,737	3-30-37	Conquest, V.
Basic alkaline earth metal sulfonates	2,402,325	6-18-46	Griesinger, W. K. and Engelkins, F. B.
Bis-(beta-naphthylamino-methyl)-para-tert-amylphenol.	2,360,324	10-17-44	Herlocker, R. D.
Calcium phthalylalkylamide	2,378,442	6-19-45	Smith, H. G., Cantrell, T. L. and Peters, J. G.
Calcium soaps and esters of Alox acids and thio-ethers.	2,389,090	11-13-45	Shields, J. E. and Bray, U. B.
Calcium sulfonate and dinnylphenyl phosphate.	2,418,422	4- 1-47	Palmer, R. C.
Carboxylic acid derivatives containing oxygen, sulfur, selenium or tellurium	2,371,143	3-13-45	Barnum, E. R. and Zublin, E. W.
	2,371,207	3-13-45	Zublin, E. W., Barnum, E. R. and White, E. R.
Chlorinated ceresin wax treated with ammonia and a carboxylic acid.	2,344,016	3-14-44	Anderson, A. P.
Degras	1,457,169	5-29-23	Howe, C. C. and Libbey, S. W.
Degras and alkali metal soaps of oil soluble sulphonic acids.	2,182,992	12-12-39	Lebo, R. B.
Degras and aniline disulfide	2,342,636	2-29-44	Beard, L. C. Jr. and Bulkley, R.
Degras fatty acids and aniline disulfide	2,378,306	5-15-45	Bishop, J. H.
Diaminoethane derivatives	2,388,059	10-30-45	Herlocker, R. D., Kleinholz, M. P. and Watkins, F. M.
Diaminomethane derivatives	2,388,058	10-30-45	Herlocker, R. D., Kleinholz, M. P. and Watkins, F. M.
Dibenzylamine	2,308,282	1-12-43	Howland, L. H. and Ter Horst, W. P.
Dicarboxylic acids	2,369,640	2-20-45	Barnum, E. R.
	2,423,865	7-15-47	White, E. R.
Diethanolamino-methyl-di-tert-amyl phenol.	2,388,057	10-30-45	Herlocker, R. D., Kleinholz, M. P. and Watkins, F. M.
Dihydroxybenzene derivatives	2,429,905	10-28-47	Wright, W. A.
Ditolyl phosphate	2,080,290	5-11-37	Benning, A. F., Benton, L. G. and Clarkson, R. G.
Esters of sorbitan or hexitan and oleic acid and sodium soaps of petroleum sulfonic acids.	2,398,193	4-16-46	Sharp, T. E.
Imido esters, imides and amidines	2,388,132	10-30-46	Fischer, P. W. and Jenkins, V. N.
Isoamyl cetyl acid phosphate reacted with a "coreamine".	2,371,851	3-20-45	Smith, H. G. and Cantrell, T. L.
Isoamyl cetyl acid phosphate reacted with dicyclohexylamine.	2,371,850	3-20-45	Smith, H. G. and Cantrell, T. L.
	2,371,852	3-20-45	Smith, H. G. and Cantrell, T. L.
Lard Oil and lecithin	2,222,487	11-19-40	Oesterlicut, J. C. D. and Quimby, W. S.
Magnesium stearate	2,373,787	4-17-45	Sharp, T. E.
Mahogany acid soaps, degras and an organic amine.	2,362,332	11- 7-44	Zimmer, J. Z. and Carlson, E. W.
Maleic acid and rosin acid condensation product.	2,363,792	11-28-44	Jahn, E. J.
Maleic anhydride reacted with olefins	2,124,628	7-26-38	Moser, F. R.
Metallic soaps of fatty acids	1,472,239	10-30-23	Buell, W. H.
Mixture of amines and phenols	2,389,110	11-13-46	Cook, E. W. and Thomas, W. D. Jr.
Multivalent metal salt of N-substituted phthalamic acid, the cyclohexylamine salt of 3-methylbutyl-2-ethylhexyl phosphate and an aliphatic amine of the latter.	2,400,611	5-21-46	Smith, H. G. and Cantrell, T. L.
N-amino-dicarboxylic acids	2,368,604-7	1-30-45	White, E. R.
Oil soluble sulfonic acid soaps	1,630,101	5-24-27	Wilkin, R. E.
Onium bases	2,340,966	3- 8-44	Smyers, W. H.
Phenolic antioxidant and cyclohexylamine oleate.	2,399,510	4-30-46	Rocchini, A. G.
Phosphoric acid ester and an alkyl amine reaction product.	2,413,852	1- 7-47	Turner, W. R.
Pine fatty acids	2,069,628	2- 2-37	Roehner, T. J.
Semilactide of hydroxylauric acid	2,403,928	7-16-46	Kleinholz, M. P.
Sodium mahogany sulfonate and zinc naphthenate.	2,415,353	2- 4-47	Johnston, R. K. and Wasson, J. L.
Sorbitan monooleate and sodium soap of sulfonic acids.	2,398,193	4- 9-46	Sharp, T. E.
Sperm oil soap and sperm anilide	2,223,458	12- 3-40	Nill, E. A.
Stearyl acid phthalate	2,284,241	5-26-42	Wernts, J. H.
Sulfonates and thiophosphoric acid esters.	2,417,876	3-25-47	Lewis, A. W. and Schott, J. E.
Thiodilauric and hydroxylauric acids	2,427,501	9-16-47	Kleinholz, M. P.
Thymol and 4-tert-butyl-1,2-benzenediol.	2,426,549	8-26-47	Coppock, W. J.
Tris-(morpholinomethyl) phenol	2,413,972	1- 7-47	Herlocker, R. D., Kleinholz, M. P. and Watkins, F. M.
Trivalent metal salts of o-phthalamidic acids.	2,408,102	9-24-46	Smith, H. G. and Cantrell, T. L.
Unsaponifiable products of oxidized petroleum	2,128,523	8-30-38	Burwell, A. W.

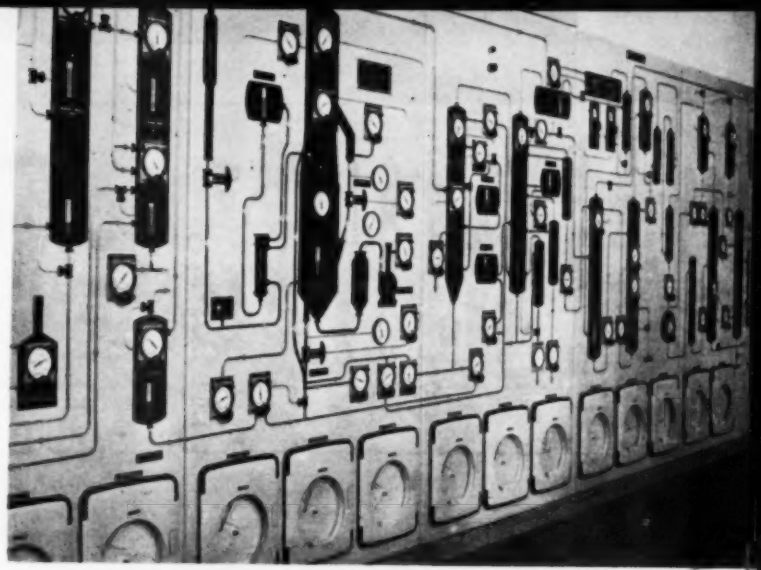


Figure 1. Graphic Panel Containing about 75 Controllers and 30 Indicators.

Process Control By Graphic Panel

DAVID M. BOYD, JR.
Universal Oil Products Company, Chicago

***THE ART** of instrumentation has passed through several stages, from locally-mounted thermometers and pressure gages to large centralized control rooms. The complexities of some modern processes and the large transmission lags have brought about the adoption of the graphic type of control panel using a simplified flow diagram as the control board and miniature control stations located on the diagram at the points they are controlling. This discussion, presented at the conference of the Instrument Society of America, held in St. Louis in September, describes the construction of such a panel, built for the Rock Island Refining Corporation at Indianapolis, containing all of the controls for a complete oil refinery including crude unit, vacuum unit, catalytic cracking unit, fractionation unit, polymerization unit, and liquefied petroleum gas unit.*

The system has been acclaimed by management groups and plant operators alike. Panellit, Inc., Chicago, who performed the mechanical design and the fabrication of the special panels and flow diagram control boards, now report that the original installation for Rock Island has been followed closely by orders from Cosden Petroleum Corporation, Wood River Refining Company, Globe Oil Company, Deep Rock Oil Company, Old Dutch Refining Company, Sun Oil Company, Tide Water Associated Oil Company, and others.

Stories current at the St. Louis exhibit of the Instrument Society of America have it that some plant operators have adopted small pipe sections to indicate the flow lines—and that one group longingly considered the possibility of moving actual fluids through glass tubes to show the nature and direction of each stream, but finally concluded that there are limits to the efforts that should be made to attain realism.

THE instrumentation of oil refineries has passed through three distinct stages and now appears to be approaching a fourth stage.

The early refining units were batch shell stills in which the crude oil was heated to a temperature high enough to boil out the gasoline and kerosine fraction. These products were sold by their specific gravities and therefore the operation of the unit was monitored by the operator taking a sample and checking it with a hydrometer to determine the cut point of a given fraction.

As competition became keener and the capacity of the units became larger the shell stills were replaced by continuous columns and the specific gravity alone was no longer an adequate means of specifying a product. Boiling ranges, initial and end point, became the primary means of specifying a product. Temperatures and pressures replaced the hydrometer as the primary means of control.

The instrumentation of the units at the end of this first stage of development consisted of thermometers and pressure gauges.

As management became more cost-conscious about the operation of the plant, recorders were added to the unit and finally, controllers were developed and installed which gave closer control of the operation of the unit than was obtained by manual operation. These instruments of this second stage of development were locally mounted, as were those of the first stage.

In the meantime there were process changes that required higher temperatures and pressures. Closer control of these temperatures and pressures was required because in many cases the yields were directly related to these variables. It became more and more desirable to locate the records centrally in order to give the operators a clearer picture of the condition of the unit at any given time.

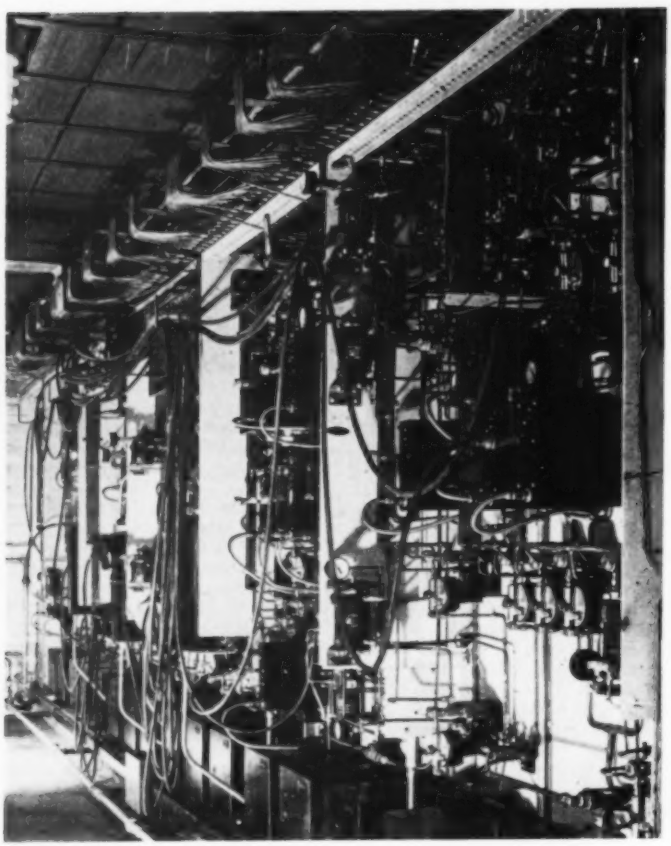
The control panel of this third stage started out in one corner of the pump room and as the units became more complicated and the instruments and controls became more numerous, the board expanded until it required a building all to itself.

It was during this stage of development that we entered into the tremendous war construction program of 100-octane gasoline and synthetic rubber plants. These plants were much more complicated than the usual plant up to this time, with the result that the control rooms were very impressive indeed. Control panels of 100 and 150 feet were not uncommon. The long rows of instruments, all looking very similar in appearance, were confusing to new operators even though they carried name plates on their cases. Probably more than one plant superintendent considered putting roller skates on his control room men.

Another problem that developed with this type of centralized control room,

Figure 2. Above—Full view of panel showing flow plan arrangement. Units shown are, left to right: Crude unit, catalytic cracking unit, fractionation unit, gas concentration unit, catalytic polymerization unit and liquefied petroleum gas unit.

Figure 3. Below—Rear view of the Graphic Panel.



and that caused concern on the part of some instrument engineers, was the amount of transmission lag that was introduced into the control system. The plants had not only grown more complicated, but had grown physically in the area covered. This growth means longer transmission lines and as a result, a certain amount of lag was introduced into the control system. This lag was not too serious in temperature, gas, pressure, or some level control problems, but was found to give trouble on liquid flow control problems, especially where the mercuryless type of flow transmitters was used.

These drawbacks to the centralized control room coupled with the inherent operational advantages of having all of the information centralized in one room, have caused a new type of control system to be considered which may well be the fourth stage in the development.

For a discussion of this type of control room it would be well to take as an example Rock Island Refining Corporation of Indianapolis, which is the first refinery using this system, to see what the problems were that caused the change to it.

This refinery operated a combined crude and thermal cracking unit and had a gas concentration and poly unit connected with it. The new construction program called for the revamp of the thermal cracking unit, a feed preparation section, the addition of a fluid catalytic cracking unit and facilities for the production of liquefied petroleum gas.

It was desired to use the existing control room for the new facilities, even though they would be about 300 feet away, in order to centralize the operation of the whole refinery. This,

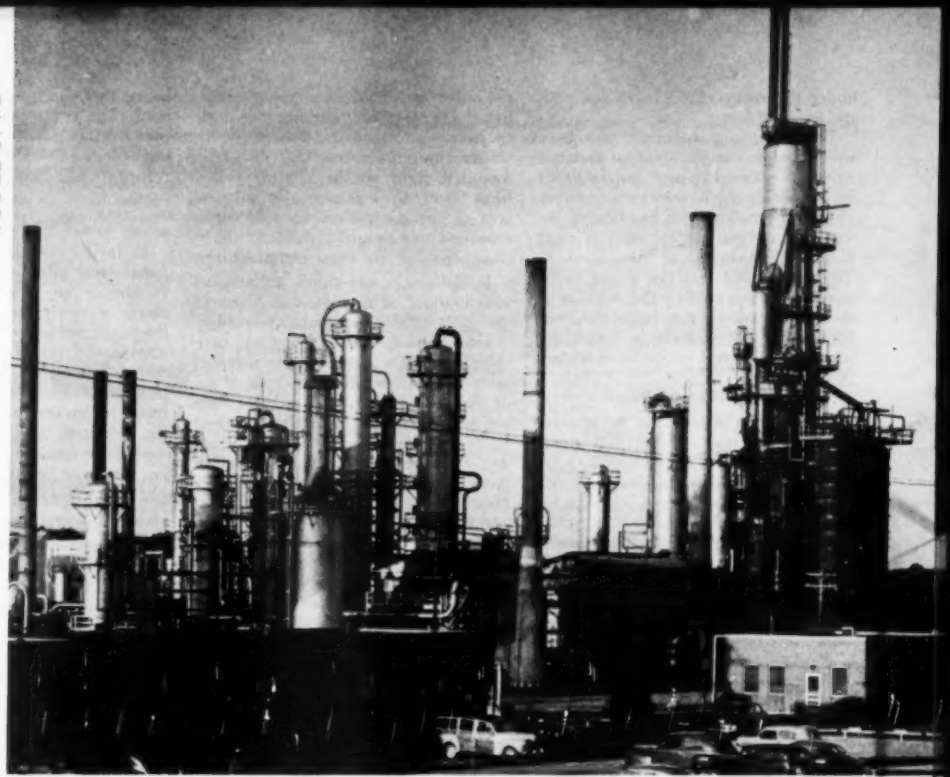


Figure 4. Photograph of the New Rock Island Refinery, Showing the New UOP Catalytic Cracking Unit at the Right and the Location of the Control Room at the Base of the Stacks at the left.

coupled with the fact that mercuryless flow transmitters were to be used on the new unit, called for the consideration of pneumatic set locally mounted controllers.

A check of the number of instruments required for the new facilities showed that the space available in the existing control room was not sufficient to hold a conventional type of instrument panel even though the whole north side of the control room were used. The existing panel covered the south wall and most of the north wall was used for light, ventilation, and a door.

All of these considerations seemed to point to the use of a new type of control system, in which the controllers would be locally mounted and would require a minimum of board space. The graphic panel type of system seemed to hold promise with its smaller type of instruments and the pneumatic set controllers where required.

A rough design of a graphic panel was made and shown to the owner of the refinery. He agreed to try it out on his new unit because he felt it would have a distinct advantage for him. This would be in the ease of training the operators on the handling of the new unit, as the flow sheet would be in front of them at all times. The owner, an engineer experienced in refinery design, seemed to like the idea quite well; he called again the next week and asked that the instrumentation of this existing plant be converted to the new system. This meant buying all new instruments.

He felt that this would be a wise investment because he found that it took him years to train an operator in his refinery and he felt that having the instruments incorporated in a flow sheet of the plant in front of the operator would speed up his training program and lessen the possibilities of having the unit upset. He also wanted to use only his existing panel space and not lose any light or ventilation from the north wall.

This was like changing the rules in the middle of the game, but a rough layout of the panel showed that it could be made to fit into the available space. Thus, it was decided to go ahead with the graphic panel board containing the whole refinery on one panel board 25 feet long. Then began the problem of working out the details.

Controller Location

One of the first points to be decided in the design of the panel was where to mount the controllers, since the field-mounted controllers required four runs of tubing as against two runs for the board-mounted controllers. The 300-foot transmission distance is the bulk of the lag in the flow control system because mercuryless flow transmitters were being used. Tests were carried out using two different force-balanced flow transmitters, two different controllers, and two different valves and positioners. These were used to control a small flow of water from a plant water line. Various lengths of tubing were used in the transmission and controller lines to give the effect of moving the controller to the control board.

With the installation a direct relationship was found to exist between the throttling range required for stability and the distance from the controller to the process. The throttling range varied from 75 percent at 10 feet to 500 percent at 300 feet transmission distance. The reset rate setting was .2 minute at 10 feet which was the fastest reset rate obtainable at this time on conventional controllers. When the transmission distance reached 300 feet the reset rate was .5 minute. All of these figures are interesting but the main factor is the actual performance of the controllers at 10 feet transmission distance and at 300 feet transmission distance. For a given upset, the area under the recovery curve of the controller at 300 feet was a matter of a hundred times greater than the area

under the recovery curve of the controller at 10 feet.

The throttling range of the controller located at the 300-foot distance could be reduced to any desired value by restricting the flow into the receiver element by means of a dampening device, but only at the sacrifice of reset rates and accuracy of measurement. The net control was not found to be materially improved by the addition of the restriction to the board-mounted controller, even though a better apparent flow record might be obtained.

Flow Controller

It is rather interesting to observe that none of the conventional pneumatically operated controllers that are in use today in oil refineries are really of a completely satisfactory design for the control of flow, in that they are proportional band controllers instead of pure proportional speed floating action. The reset rates that are available on the conventional controllers are about ten times slower than can be used with locally mounted controllers and mercuryless flow transmitters. Probably the main reason that the available proportional speed floating controllers are not used is that they are too bulky and expensive. A market appears for a small, simple, pre-engineered proportional speed floating controller, preferably one that could be mounted right on the control valve. Flow controllers account for 50 percent of the controllers used in refineries and this should provide an interesting market for some manufacturer.

In designing this panel, a considerable amount of thought was given to the question of which points to record. When the owner of the plant was consulted, he indicated that he was not interested in permanent records of all of the controllers, because these data are recorded on the operator's log sheet every hour or two and the records are not consulted very often after they have been removed from the instrument except for accounting purposes and to show temperature trends.

Five pneumatic recorders were provided, each of which contained four pens, giving twenty recorder points in all for the seventy-six controllers and approximately thirty indicators that were used on this plant. These recorders are all 3 to 15-pound receivers and are provided with snap couplings so that they can be plugged into any of the controllers or indicators on the board that the operator desires to record. The temperature transmitters used on this panel were of the recording type, so that they gave continuous records of the temperature trends at all times.

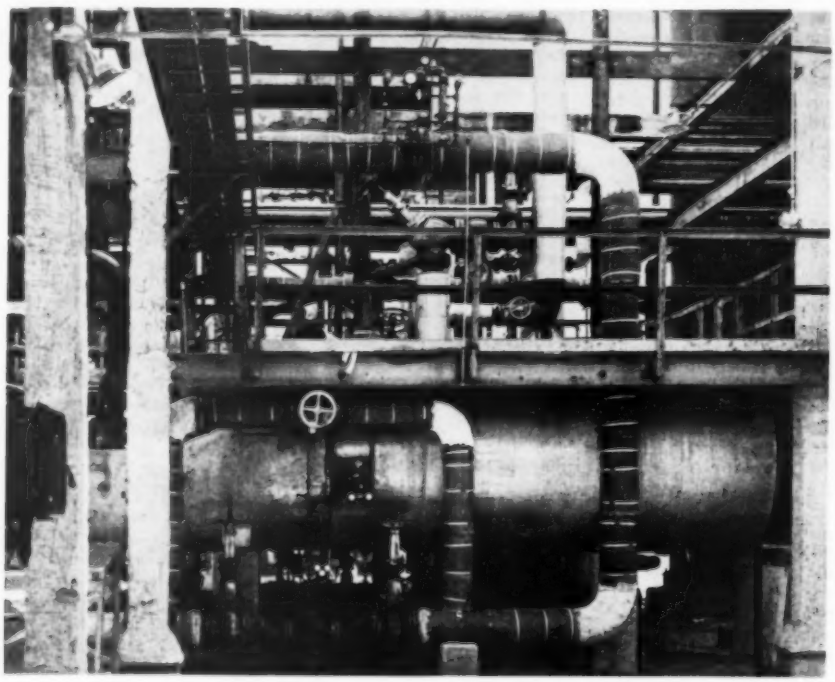
Panel Layout

In laying out the flow plan on the panel every effort was made to keep it as simple as possible. Only major pieces of equipment and process flow lines are shown, such as towers, reactors, and heaters. Heat exchangers and pumps are not shown on the panel, because it was felt that they would result in unnecessary complications in the design of the panel. It was not intended to make the panel a detailed flow sheet of the plant. The purpose is to give the operator a quick generalized view of his process so that he can more readily visualize the part each controller plays in the process, without carrying the details to such an extent that it becomes a toy.

ACKNOWLEDGMENT

I wish to express my appreciation to L. E. Winkler of the Rock Island Refining Corporation for allowing us to use the data obtained in his plant and to L. E. Stewart of Universal Oil Products Company for his help in running the flow tests.

Figure 5. Typical Field Installation Showing Flow Transmitter on Line at Top of Photograph with Controller and Valve Located on Line at the Bottom of Photograph.



IN PREVIOUS papers[14, 15, 16, 17, 18] the principal thermodynamic properties of the lower members of the paraffinic monoolefinic, cycloparaffinic and aromatic series of hydrocarbons have been presented. This paper which contains the light diolefins and acetylenes completes an initial survey of the strictly carbon-hydrogen group of compounds. Additional important hydrocarbons in these series will be presented later as reliable data become available.

THERMOCHEMISTRY for the Petrochemical Industry

Part VI—Acetylenes and Diolefins

KENNETH A. KOBE and ERNEST G. LONG
Department of Chemical Engineering
University of Texas, Austin

TABLE 1
Reported Heat Capacities of Acetylenes and Diolefins

Compound	Temperature Range	Method	Workers	Reference
Acetylene	293 °K.	Calorimetric	Schweikert	24
	−71 to +18 °C.	Calorimetric	Heuse	7
	173 to 279 °K.	Calorimetric	Eucken and Bertram	5
	0 to 300 °C.	Modified Spectroscopic	Beeck	3
	300 to 1300 °K.	Spectroscopic	Frost	6
		Spectroscopic	Ruedy	22
	250 to 1500 °K.	Spectroscopic	Stull and Mayfield	26
	0 to 1700 °C.	Spectroscopic	Schuster	23
	0 to 1000 °C.	Spectroscopic	Justi and Luder	8
	298 to 1500 °K.	Spectroscopic	Wagman, Kilpatrick, Pitzer and Rossini	28
	273 to 1500 °K.	Compilation	API 44	20
Methyl-acetylene	272 to 369 °K.	Calorimetric	Kistiakowsky and Rice	12
	158 to 339 °K.	Calorimetric	Kistiakowsky, Lacher and Ransom	11
	300 to 370 °K.	Calorimetric	Kistiakowsky and Rice	13
	20 to 140 °C.	"Accommodation Coefficient"	Beeck	3
	158 to 339 °K.	Spectroscopic	Kistiakowsky and Rice	12
	250 to 1500 °K.	Spectroscopic	Stull and Mayfield	26
	298 to 1500 °K.	Spectroscopic	Wagman, Kilpatrick, Pitzer and Rossini	29
	273 to 1500 °K.	Compilation	API 44	20
Dimethyl-acetylene	307 to 371 °K.	Calorimetric	Kistiakowsky and Rice	13
	250 to 1500 °K.	Spectroscopic	Stull and Mayfield	26
	298 to 1500 °K.	Spectroscopic	Wagman, Kilpatrick, Pitzer and Rossini	29
	273 to 1500 °K.	Compilation	API 44	20
Propadiene (Allene)	272 to 366 °K.	Calorimetric	Kistiakowsky and Rice	12
	148 to 344 °K.	Calorimetric	Kistiakowsky, Lacher and Ransom	11
	20 to 140 °C.	"Accomodation Coefficient"	Beeck	3
	250 to 1500 °K.	Spectroscopic	Stull and Mayfield	26
	100 to 1000 °K.	Spectroscopic	Linnett and Avery	19
	298 to 1500 °K.	Spectroscopic	Kilpatrick, Beckett, Prosen, Pitzer and Rossini	9
	273 to 1500 °K.	Compilation	API 44	20
Butadiene 1-3	300 to 363 °K.	Ultra-sound	Aston, Moessen, Hardy and Szasz	1
	−35 to +60 °C.	Calorimetric	Scott and Meliere	25
	5 to 105 °C.	Calorimetric	Templeton and Davies and Fehing	28
	250 to 1500 °K.	Spectroscopic	Stull and Mayfield	26
	298 to 1500 °K.	Spectroscopic	Zeise	30
	298 to 1500 °K.	Spectroscopic	Aston, Szasz, Wooley	2
	273 to 1500 °K.	Compilation	API 44	20
Isoprene	23 to 298 °K.	Calorimetric (Solid and Liquid)	Bekkedahl and Wood	4
	250 to 1500 °K.	Spectroscopic	Stull and Mayfield	26
	298 to 1500 °K.	"Increments"	Kilpatrick, Beckett, Prosen, Pitzer and Rossini	9
	273 to 1500 °K.	Compilation	API 44	20

TABLE 2
Free Energies of Formation, Heats of Formation and Heats of Combustion of Acetylenes and Diolefins, at 25° C.[1]

	Molecular Weight	ΔG°_f Cal./g-mole	ΔH°_f Cal./g-mole	$-\Delta H^\circ_c$, cal./g-mole H_2O (liq.) CO_2 (gas)	$-\Delta H^\circ_c$, cal./g-mole H_2O (gas) CO_2 (gas)
Acetylene	26.036	50,000	54,194	310,615	300,000
Methylacetylene	40.062	46,313	44,319	453,109	442,070
Di-methylacetylene	54.088	44,723	35,574	616,533	584,974
Propadiene	40.062	48,370	45,920	464,710	443,670
1-3, Butadiene	54.088	36,430	26,750	607,910	576,350
Isoprene	68.114	34,870	18,100	761,630	719,550

[1] ΔH°_c represents the heat evolved at 25 °C. and constant pressure in the combustion of the gaseous hydrocarbon in gaseous oxygen to form the products indicated with all the reactants and products in their appropriate standard reference states.

ΔH°_f and ΔG°_f represent the changes in the heat content (enthalpy) and free energy, respectively, for the formation of the gaseous hydrocarbons from the elements, with all the reactants and products in their appropriate standard reference states.

TABLE 3
Heat Capacities of Acetylenes and Diolefins
cal./g-mole · °C.

°C.	Acetylene	Methyl-Acetylene	Dimethyl-Acetylene	Propadiene	Butadiene 1-3	Isoprene
0	10.04	13.74	17.63	13.26	17.55	23.3
18	10.37	14.28	18.43	13.86	18.80	24.5
25	10.50	14.49	18.63	14.10	19.01	25.0
100	11.64	16.62	21.56	16.43	22.09	30.2
200	12.73	19.13	25.39	19.16	27.45	35.8
300	13.54	21.28	28.83	21.45	31.02	40.3
400	14.21	23.13	31.85	23.38	33.87	44.1
500	14.79	24.74	34.40	25.02	36.26	47.3
600	15.31	26.16	36.79	26.45	38.31	49.9
700	15.80	27.40	38.80	27.69	40.08	52.3
800	16.24	28.50	40.54	28.77	41.64	54.4
900	16.64	29.46	42.06	29.72	42.99	56.2
1000	17.01	30.29	43.38	30.55	44.17	57.8
1100	17.33	31.03	44.53	31.27	45.22	59.2
1200	17.63	31.68	45.53	31.91	46.13	60.4

TABLE 4
Heat Capacities of Acetylenes and Diolefins
cal./g-mole · °K.

°K.	Acetylene	Methyl-Acetylene	Dimethyl Acetylene	Propadiene	Butadiene 1-3	Isoprene
273	10.04	13.74	17.63	13.26	17.55	23.2
291	10.37	14.28	18.43	13.86	18.80	24.5
298	10.50	14.50	18.63	14.10	19.01	25.0
300	10.53	14.55	18.70	14.16	19.11	25.2
400	11.97	17.33	22.62	17.21	24.29	31.8
500	12.97	19.74	26.36	19.82	28.52	37.1
600	13.73	21.80	29.68	22.00	31.94	41.4
700	14.37	23.58	32.59	23.84	34.55	45.0
800	14.93	25.14	35.14	25.42	36.84	48.0
900	15.45	26.51	37.36	26.80	38.81	50.6
1000	15.92	27.71	39.29	28.00	40.52	52.9
1100	16.35	28.77	40.98	29.04	42.02	54.9
1200	16.74	29.69	42.44	29.96	43.32	56.6
1300	17.10	30.50	43.71	30.75	44.47	58.2
1400	17.42	31.21	44.82	31.45	45.47	59.5
1500	17.70	31.84	45.78	32.08	46.34	60.6

THE spectroscopic calculations of Wagman, Kilpatrick, Pitzer and Rossini[29] constitute a reliable source for the thermodynamic properties of the acetylenes. The calorimetric determinations of Kistiakowsky and co-workers[11, 12, 13] are good checks for the spectroscopic values for methyl- and dimethyl- acetylene. For acetylene the best calorimetric values are probably those of Eucken and Bertram[5]. The data for the acetylenes used in this paper and in the API 44 report[20] are from the calculations of Wagman, Kilpatrick, Pitzer and Rossini[29].

Spectroscopic determinations of the heat capacity of propadiene (allene) have been made by Kilpatrick, Beckett, Prosen, Pitzer and Rossini[9] and will be published shortly[21]. It is these calculations that appear in the API 44 report and they are used in this paper. Good agreement is shown between these spectroscopic values and the calorimetric determinations of Kistiakowsky and co-workers[11, 12].

The best work on butadiene 1-3 is that of Aston, Szasz, Wooley and Brickwedde[2]. It has been used here and in the

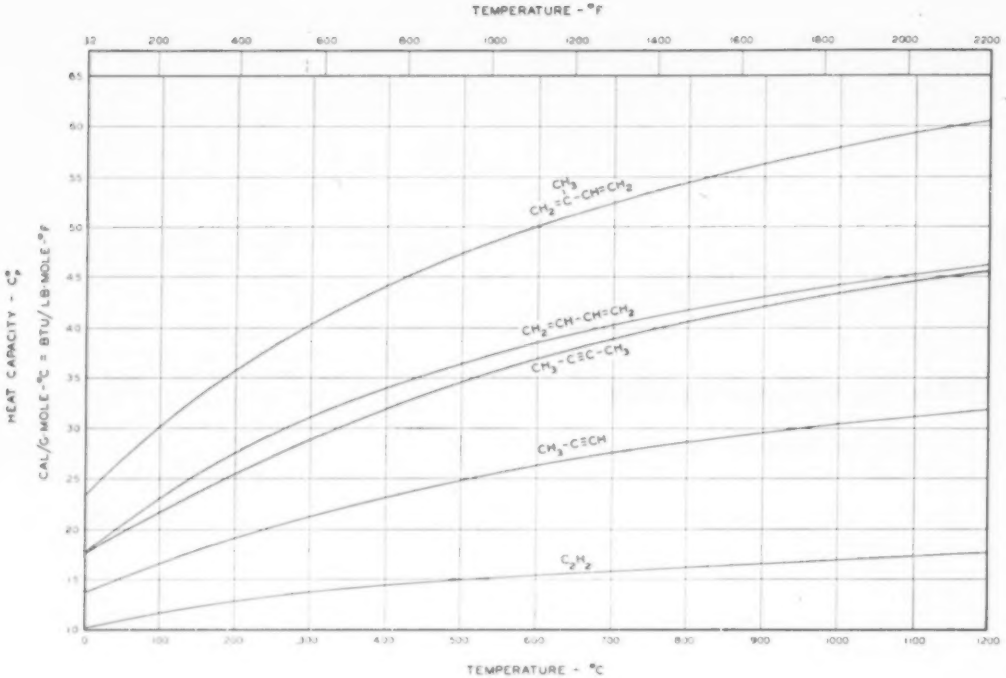


FIGURE 1
Heat Capacity Curves for Acetylene, Methylacetylene, Dimethylacetylene, Propadiene, Butadiene 1,3 and Isoprene.

TABLE 5
Heat Capacities of Diolefins and Acetylenes
Btu./lb.-mole · °F.

°F.	Acetylene	Methyl-Acetylene	Dimethyl-Acetylene	Propadiene	Butadiene 1-3	Isoprene
32	10.04	13.73	17.63	13.26	17.55	23.2
60	10.33	14.20	18.24	13.79	18.45	24.3
77	10.50	14.49	18.63	14.10	19.01	25.0
100	10.71	14.85	19.11	14.51	19.71	26.0
200	11.54	16.43	21.31	16.33	22.65	29.7
300	12.22	17.58	22.46	17.81	25.29	33.0
400	12.76	19.22	25.53	19.26	27.63	36.0
500	13.23	20.54	27.49	20.57	29.69	38.6
600	13.64	21.57	29.31	21.76	31.48	40.9
700	14.01	22.60	31.00	22.84	33.08	43.0
800	14.37	23.58	32.59	23.84	34.55	45.0
900	14.68	24.45	34.02	24.73	35.84	46.7
1000	14.98	25.28	35.37	25.56	37.04	48.3
1100	15.27	26.05	36.62	26.34	38.16	49.7
1200	15.55	26.77	37.76	27.06	39.18	51.1
1300	15.81	27.44	38.86	27.73	40.13	52.4
1400	16.06	28.06	39.85	28.34	41.01	53.5
1500	16.30	28.64	40.77	28.91	41.83	54.6
1600	16.52	29.17	41.62	29.45	42.59	55.6
1700	16.74	29.69	42.44	29.96	43.32	56.6
1800	16.95	30.13	43.14	30.39	43.95	57.5
1900	17.12	30.57	43.81	30.81	44.56	58.3
2000	17.30	30.97	44.43	31.20	45.12	59.1
2100	17.47	31.34	45.01	31.57	45.64	59.7
2200	17.63	31.68	45.54	31.91	46.13	60.4

TABLE 6
Heat Capacities of Diolefins and Acetylenes
Btu./lb.-mole · °R.

°R.	Acetylene	Methyl-Acetylene	Dimetyhl Acetylene	Propadiene	Butadiene 1-3	Isoprene
492	10.04	13.73	17.63	13.26	17.55	23.2
500	10.12	13.86	17.80	13.41	17.81	23.5
520	10.33	14.20	18.34	13.78	18.45	24.3
537	10.50	14.49	18.63	14.10	19.01	25.0
600	11.04	15.49	19.99	15.20	20.99	27.5
700	11.82	17.03	22.18	16.85	23.74	31.1
800	12.44	18.42	24.29	18.49	26.23	34.2
900	12.97	19.74	26.36	19.92	28.52	37.1
1000	13.39	20.89	28.22	21.05	30.41	39.5
1100	13.80	22.00	30.01	22.21	32.15	41.8
1200	14.15	22.99	31.64	23.24	33.67	43.8
1300	14.49	23.93	33.16	24.20	35.07	45.7
1400	14.81	24.80	34.58	25.08	36.34	47.4
1500	15.10	25.59	35.87	25.87	37.49	48.9
1600	15.39	26.36	37.11	26.65	38.59	50.3
1700	15.65	27.04	38.21	27.33	39.56	51.6
1800	15.92	27.71	39.29	28.00	40.52	52.9
1900	16.16	28.29	40.22	28.57	41.34	54.0
2000	16.39	28.87	41.14	29.14	42.16	55.1
2100	16.61	29.38	41.95	29.65	42.88	56.0
2200	16.82	29.87	42.73	30.14	43.58	56.9
2300	17.02	30.32	43.43	30.57	44.21	57.8
2400	17.21	30.73	44.06	30.97	44.78	58.6
2500	17.38	31.13	44.72	31.37	45.35	59.4
2600	17.34	31.49	45.24	31.72	45.85	59.9

API 44 report and is in good agreement with the recent calorimetric work noted in Table 2.

For isoprene (2-methyl-1, 3-butadiene) the available thermal, spectroscopic and other molecular data are insufficient to permit satisfactory statistical treatment. Accordingly, the method of calculation used by Kilpatrick, Beckett, Prosen, Pitzer and Rossini[9] is that of increments, in which the regularity in the properties of related compounds is utilized. The same method has recently been used for methylcylopentane[10] and cumene.[27] The following equation was used by Kilpatrick, Beckett, Prosen, Pitzer and Rossini for the heat capacity of isoprene:

$$C_p(\text{isoprene}) = C_p(\text{isobutene}) + C_p(\text{butadiene 1-3}) - C_p(\text{propylene}). \quad (1)$$

The values obtained by the above formula are used by the API 44 report and in this paper.

Table 1 is a summary of both the calorimetric and statistical work which has been done on this group of compounds. The standard free energies and heats of formation and the standard heats of cumbustion are listed

TABLE 7
Enthalpies of Acetylenes and Diolefins
cal./g-mole

°C.	Acetylene	Methyl-Acetylene	Dimethyl-Acetylene	Propadiene	Butadiene 1-3	Isoprene
0	0.0	0.0	0.0	0.0	0.0	0.0
18	183.8	252.2	323.5	244.1	325.2	430.0
25	256.9	352.9	453.2	342.0	456.9	603.3
100	1088.	1521.	1962.	1489.	2035.	2677.
200	2309.	3339.	4312.	3272.	4564.	5985.
300	3623.	5366.	7024.	5304.	7493.	9803.
400	5018.	7551.	10060.	7578.	10736.	14020.
500	6468.	9944.	13380.	9998.	14240.	18590.
600	7964.	12530.	16940.	12540.	17980.	23450.
700	9520.	15200.	20720.	15250.	21980.	28560.
800	11120.	17990.	24690.	18070.	25980.	33890.
900	12770.	20860.	28820.	21030.	30210.	39430.
1000	14480.	23850.	33090.	24040.	34560.	45120.
1100	16160.	26950.	37480.	27100.	39030.	50960.
1200	17910.	30080.	41980.	30250.	43600.	56930.

TABLE 8
Enthalpies of Acetylenes and Diolefins
cal./g-mole

°K.	Acetylene	Methyl-Acetylene	Dimethyl Acetylene	Propadiene	Butadiene 1-3	Isoprene
273	0.0	0.0	0.0	0.0	0.0	0.0
291	183.8	252.2	323.5	244.1	325.2	430.0
298	256.9	352.9	453.2	342.0	456.9	603.3
300	277.9	382.0	490.5	370.3	495.0	653.
400	1410.	1974.	2552.	1965.	2664.	3507.
500	2659.	3826.	5002.	3823.	5307.	6960.
600	3994.	5904.	7804.	5914.	8327.	10890.
700	5391.	8209.	10919.	8176.	11652.	15210.
800	6856.	10646.	14306.	10639.	15221.	17230.
900	8383.	13190.	17930.	13280.	19000.	24800.
1000	9951.	15900.	21760.	16020.	22960.	29970.
1100	11565.	18730.	25770.	18870.	27090.	35360.
1200	13210.	21680.	29940.	21790.	31360.	40920.
1300	14900.	24690.	34250.	24820.	35750.	46660.
1400	16640.	27740.	38680.	27970.	40240.	52550.
1500	18390.	30900.	43210.	31140.	44830.	58550.

in Table 2. For the most part these were taken directly from the API 44 report but in some cases had to be calculated from other data in the report.

The recommended molal heat capacities on all four temperature scales are shown in Tables 3, 4, 5 and 6 and are graphically presented in Figure 1. The corresponding heat content values relative to O°C. = 32°F., obtained by careful integration are presented as Tables 7, 8, 9 and 10. These enthalpy values are also given by Figure 2, a double logarithmic plot of enthalpy and temperature. The numerical equivalents of the relative heat contents are presented as mean molal heat capacities on the Centigrade and Fahrenheit scales in Tables 11 and 12, respectively. The cubic heat capacity equations are given in Table 13.

ACKNOWLEDGMENT

The authors wish to express their thanks to Dr. F. D. Rossini of the National Bureau of Standards for an advance manuscript copy of "Heats, Equilibrium Constants, and Free Energies of Formation of the Diolefins, C_3 to C_8, and the Styrenes, C_8 and C_9" by J. E. Kilpatrick, C. W. Beckett, E. J. Prosen, K. S. Pitzer and F. D. Rossini.

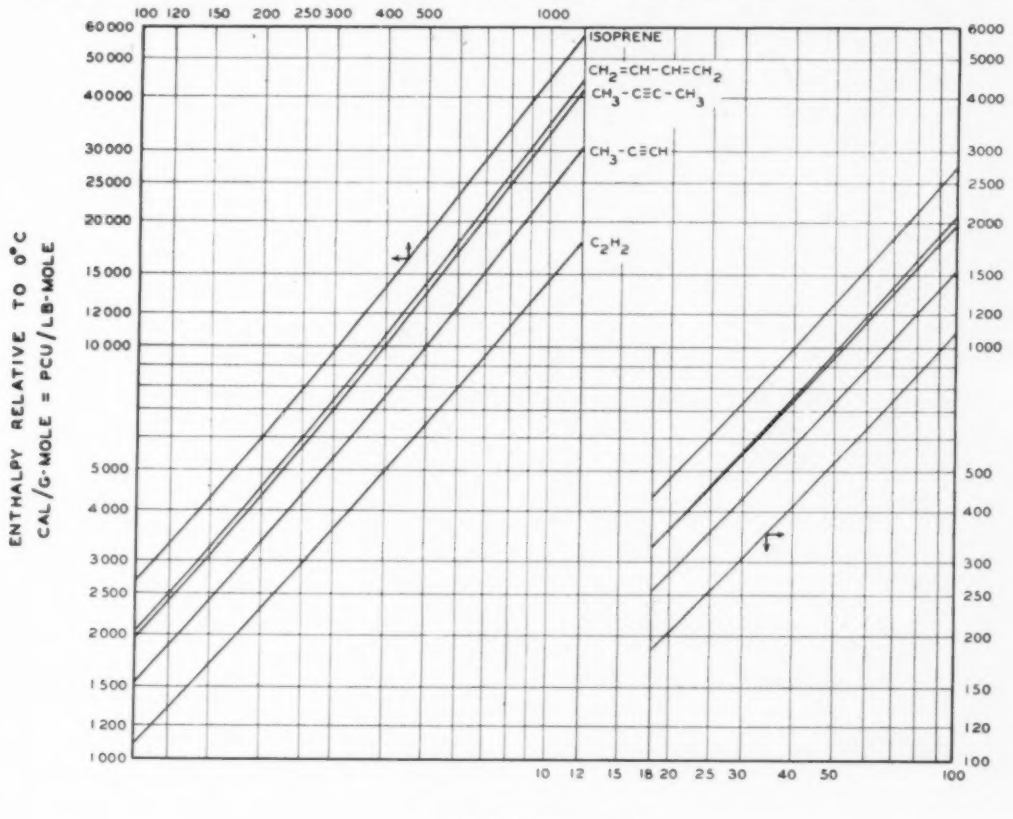


FIGURE 2
Relative Enthalpies for Acetylene, Methylacetylene, Dimethylacetylene, Propadiene, Butadiene 1,3 and Isoprene. Multiply readings in Pcu./lb.-mole by 1.8 to obtain Btu./lb.-mole.

TABLE 9

Enthalpies of Diolefins and Acetylenes
Btu./lb.-mole

°F.	Acetylene	Methyl-Acetylene	Dimethyl-Acetylene	Propadiene	Butadiene 1-3	Isoprene
32	0.0	0.0	0.0	0.0	0.0	0.0
60	285.3	391.2	392.3	378.6	504.0	606.
77	462.4	635.2	615.8	615.6	822.4	1086.
100	786.4	972.8	1290.	944.7	1264.	1673.
200	1819.	2338.	2274.	2485.	3389.	4460.
300	3098.	4307.	5514.	4188.	5788.	7890.
400	4258.	6164.	7965.	6043.	8436.	11960.
500	5558.	8148.	10617.	8035.	11300.	14800.
600	6902.	10260.	13460.	10150.	14360.	18780.
700	8285.	12470.	16470.	12380.	17590.	22960.
800	9704.	14780.	19630.	14720.	20970.	27380.
900	11160.	17180.	22990.	17130.	24490.	31970.
1000	12640.	19670.	26490.	19660.	28140.	36720.
1100	14150.	22230.	30080.	22280.	31900.	41620.
1200	15690.	24870.	33780.	24930.	35790.	46660.
1300	17260.	27580.	37610.	27670.	39730.	51830.
1400	18860.	30360.	41540.	30470.	43790.	57130.
1500	20470.	33200.	45570.	33330.	47930.	62530.
1600	22120.	36090.	49690.	36250.	52150.	68040.
1700	23790.	39030.	53900.	39220.	56450.	73650.
1800	25480.	42020.	58180.	42240.	60810.	79340.
1900	27170.	45060.	62520.	45300.	65240.	85150.
2000	28860.	48130.	66940.	48400.	69720.	91020.
2100	30630.	51250.	71410.	51540.	74260.	96960.
2200	32340.	54400.	75940.	54710.	78850.	102960.

TABLE 10

Enthalpies of Diolefins and Acetylenes
Btu./lb.-mole

°R.	Acetylene	Methyl-Acetylene	Dimethyl Acetylene	Propadiene	Butadiene 1-3	Isoprene
492	0.0	0.0	0.0	0.0	0.0	0.0
500	80.6	110.4	141.8	105.7	141.4	186.8
520	285.3	391.2	392.3	378.6	504.0	606.
537	462.4	635.2	615.8	615.6	822.4	1086.
900	1155.	1582.	2034.	1540.	2081.	2743.
700	2300.	3210.	4148.	3198.	4316.	5683.
800	3515.	4982.	6469.	4985.	6815.	8953.
900	4786.	6897.	9003.	6881.	9353.	12320.
1000	6105.	8920.	11730.	8925.	12500.	16330.
1100	7465.	11070.	14650.	11080.	15630.	20420.
1200	8863.	13320.	17730.	13360.	18920.	24700.
1300	10295.	15660.	20970.	15730.	22360.	29180.
1400	11760.	18100.	24360.	18200.	25930.	33840.
1500	13290.	20620.	27880.	20750.	29620.	38660.
1600	14780.	23220.	31530.	23370.	33420.	43620.
1700	16330.	25890.	35290.	26070.	37330.	48720.
1800	17910.	28620.	39170.	28840.	41340.	53940.
1900	19520.	31420.	43140.	31670.	45430.	59290.
2000	21140.	34280.	47210.	34530.	49600.	64740.
2100	22780.	37200.	51370.	37490.	53860.	70300.
2200	24470.	40160.	55600.	40480.	59180.	75940.
2300	26160.	43170.	59910.	43520.	62570.	81680.
2400	27870.	46220.	64290.	46600.	67020.	87500.
2500	29600.	49310.	68730.	49710.	71530.	93400.
2600	31350.	52450.	73220.	52870.	76080.	99370.

TABLE 11

Mean Heat Capacities of Acetylenes and Diolefins
cal./g-mole • °C.

°C.	Acetylene	Methyl-Acetylene	Dimethyl-Acetylene	Propadiene	Butadiene 1-3	Isoprene
0	10.04	13.74	17.63	13.26	17.55	23.2
18	10.21	14.01	17.97	13.56	18.17	23.9
25	10.28	14.12	18.13	13.68	18.28	24.1
100	10.88	15.21	19.62	14.89	20.35	26.8
200	11.55	16.70	21.56	16.36	22.82	29.9
300	12.08	17.88	23.41	17.68	24.98	32.7
400	12.55	18.89	25.15	18.93	26.84	35.0
500	12.94	19.80	26.75	20.00	28.49	37.2
600	13.27	20.88	28.24	20.90	29.96	39.1
700	13.60	21.72	29.60	21.78	31.28	40.8
800	13.90	22.48	30.86	22.50	32.47	42.4
900	14.19	23.18	32.02	23.36	33.56	43.8
1000	14.46	23.85	33.09	24.04	34.56	45.1
1100	14.69	24.50	34.08	24.63	35.49	46.3
1200	14.93	25.06	34.99	25.21	36.33	47.4

TABLE 12

Mean Heat Capacities of Acetylenes and Diolefins
Btu./lb.-mole • °F.

°F.	Acetylene	Methyl-Acetylene	Dimethyl Acetylene	Propadiene	Butadiene 1-3	Isoprene
32	10.04	13.74	17.63	13.26	17.55	23.2
60	10.19	13.97	17.94	13.52	18.00	23.8
77	10.28	14.12	18.13	13.68	18.28	24.1
100	10.39	14.31	18.38	13.89	18.65	24.6
200	10.83	15.11	19.49	14.79	20.17	26.5
300	11.22	16.07	20.87	15.63	21.60	28.4
400	11.57	16.75	21.94	15.42	22.92	30.1
500	11.88	17.41	22.69	17.17	24.15	31.6
600	12.15	18.06	23.69	17.87	25.29	33.1
700	12.40	18.66	24.66	18.54	26.33	34.4
800	12.64	19.24	25.59	19.16	27.31	35.7
900	12.85	19.79	26.48	19.75	28.22	36.8
1000	13.06	20.32	27.33	20.31	29.07	37.9
1100	13.25	20.82	28.14	20.84	29.87	39.0
1200	13.44	21.30	28.92	21.34	30.62	39.9
1300	13.61	21.75	29.66	21.82	31.33	40.9
1400	13.78	22.19	30.37	22.27	32.01	41.8
1500	13.95	22.61	31.04	22.71	32.68	42.6
1600	14.11	23.01	31.69	23.12	33.26	43.4
1700	14.26	23.40	32.31	23.51	33.84	44.2
1800	14.40	23.77	32.90	23.89	34.39	44.9
1900	14.54	24.12	33.47	24.25	34.92	45.6
2000	14.68	24.46	34.01	24.59	35.43	46.2
2100	14.81	24.78	34.53	24.92	35.91	46.9
2200	14.94	25.09	35.03	25.24	36.37	47.5

TABLE 13

Heat Capacity Equations for Acetylenes and Diolefins
cal./g-mole • °C. or °K.
Btu./lb.-mole • °F. or °R.

Compound		a	$b \cdot 10^2$	$c \cdot 10^5$	$d \cdot 10^9$	Percent Max. Error	Percent Average Error
Acetylene	°C.	10.14	1.4456	−1.203	4.349	1.46	0.59
	°K.	5.21	2.2008	−1.559	4.349		
	°F.	9.89	0.8273	−0.3783	0.7457		
	°R.	5.21	1.2237	−0.4812	0.7457		
Methyl-Acetylene	°C.	13.79	2.982	−1.806	4.713	0.36	0.13
	°K.	4.21	4.073	−2.192	4.713		
	°F.	13.27	1.692	−0.5650	0.8091		
	°R.	4.21	2.263	−0.6765	0.8091		
Dimethyl-Acetylene	°C.	17.52	4.442	−2.353	4.974	0.70	0.16
	°K.	3.54	5.838	−2.760	4.974		
	°F.	16.74	2.513	−0.7342	0.8529		
	°R.	3.54	3.243	−0.8519	0.8529		
Propadiene	°C.	13.30	3.319	−2.250	6.484	0.37	0.19
	°K.	2.43	4.693	−2.781	6.484		
	°F.	12.71	1.808	−0.7049	1.112		
	°R.	2.43	2.607	−0.8583	1.112		
Butadiene 1-3	°C.	17.64	8.621	−4.416	14.24	0.91	0.47
	°K.	−1.39	8.350	−5.582	14.24		
	°F.	16.72	3.209	−1.3858	2.442		
	°R.	−1.39	4.639	−1.723	2.442		
Isoprene	°C.	23.30	7.104	−5.275	16.93	0.99	0.43
	°K.	−0.44	10.418	−6.782	16.93		
	°F.	22.05	4.052	−1.9884	2.903		
	°R.	−0.44	5.788	−2.067	2.903		

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Insulation of Steam-Traced Refinery Line

AN EXAMPLE of efficient and economical insulation of a type of pipe line to which standard sectional pipe covering is not well adapted is provided by an application of "fiberglas aerocor" insulation to a six-inch pipe line traced with a one-half-inch steam line at Gulf Refining Company's Toledo refinery.

The Toledo refinery line is typical of oil and chemical lines in many process plants and refineries which must be kept heated by a steam tracer to maintain proper viscosity during cold weather and permit pumping of the material from process point to storage, or, in the case of water lines, to prevent freezing during periods of intermittent flow in cold weather. The only feasible way to insulate such lines is to wrap the carrier line and the steam line as one. The same is true of any group of lines when the adjacent pipes are too close to each other to permit them to be insulated individually.

The material used for the Toledo job is a blanket type, flexible and with a density of one and one-half pounds per cubic foot, composed of extremely fine glass fibers bonded with a thermosetting resin. It was furnished in compressed roll packages, with dimensions of the material one-half inch, by 36 inches, by 100 feet. The rolls were first cut into lengths sufficient to provide a double wrap around the two lines, with a three-inch overlap. Each cut piece was rolled and secured with a piece of gummed tape so that it could be handled easily before application, by the two-man crew.

The pre-cut pieces were fitted snugly around the two lines and spirally wrapped, on approximately eight-inch centers, with fiberglas tape one and one-half inches wide and 0.005-inch thick. Due to the high resilience of the blanket covering, it was not necessary to lap one section over the next, and each 36-inch length was merely butted tightly against the next section. The finish used on the part of the line exposed to the weather was 45-pound roofing felt, wired on with loops on 6-inch centers. Under shelter, the line was wrapped with red rosin paper and finished with canvas, pasted or sewed.

This provides a fire-safe, inorganic, rot-proof insulation with high resistance to heat flow, which can be used up to maximum temperature of 600° F. A cost comparison with a standard material used for similar jobs shows that material costs are about the same, but that the reduction in fabrication and application costs results in a substantial over-all saving. The installation of the Aerocor at the Toledo Gulf refinery was by Service Products, Inc., Toledo.

Photo at top shows workmen wrapping "aerocor" snugly around both the carrier line and the steam tracer line. Middle photo: Fiberglas tape is applied on approximately 8-inch centers. Bottom: Roofing felt finish is wired securely in place.

Assembly for combination hose mask, including face-piece, corrugated breathing tubes and Y connections, welding and lenses and chrome leather hood. The hood is so arranged that the exhaust air, when using air-supplied masks, can be directed against and cool the workman's body. The hood also protects the workman from ultra-violet ray burns.

New Welder's Head-Piece For Work in Toxic Atmosphere

WILLIAM A. NEWMAN

Safety Department, Ethyl Corporation, New York

A PROBLEM common to many industries engaged in storing and handling toxic materials is that of repairing tanks and other equipment by means of acetylene or arc welding operations. There are many instances in which, even after all the hazards of explosion and fire have been eliminated, the element of toxicity still remains or is created by the heat of welding.

Heretofore, the difficulty has been that conventional welding equipment offered the workman no respiratory protection while working in a toxic atmosphere. For that reason, it was frequently necessary, as in the case of storage tanks that have contained gasoline, to remove the lead sludge that had accumulated after long periods of storage, to free the tank of gasoline vapors, to clean thoroughly the metallic surface to be welded or cut, and to provide a continuous circulation of air within the tank while the welder was at work inside. This, of course, is both expensive and time-consuming.

A "DISTINCT contribution to safety equipment" is how the new face-piece for welders is described in the accompanying article. It was developed over a period of nine years in order to overcome the hazards of entering and working in tanks used for storage of petroleum products without extensive and expensive precautionary measures having first been taken. With the new face-piece, all that is required is to gas-free the tank to eliminate the possibility of explosion. Then, with this new equipment, a welder can work inside with full protection against all toxic vapors, dust and fumes and against any oxygen deficiency.

Now, however, it is possible for a welder to work conveniently in any atmosphere from which the danger of explosion has been eliminated, with complete protection against the hazards of toxic vapors, dusts and fumes.

The device that makes this possible is a comparatively simple one. Yet it combines into one unit the protection provided by conventional welding goggles and shields—against impact and harmful radiation—with the respiratory protection afforded by conventional air-line masks.

The new device is a welder's face-piece. The assembly consists of an air-tight rubber mask and chrome leather hood, the corrugated breathing tubes and connections, and a combination frame and flip-front which contain the welding and cover lenses.

Three Lenses

The most distinctive part of the new face-piece is the frame and flip-front assembly for holding the lenses. Three lenses are employed. One of them is a safety lens permanently sealed into the mask, providing an air-tight seal against the atmosphere. The other two lenses, which are welding and pitting lenses, are inserted in the flip-front, and can be removed.

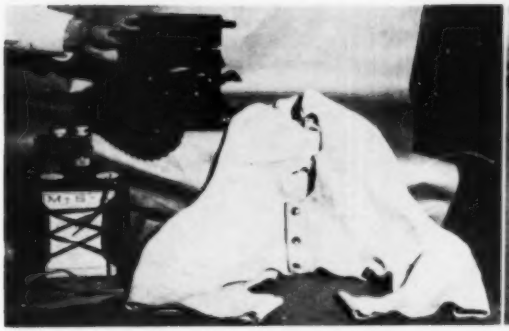
The arrangement of the lenses has a number of advantages. The permanently sealed lens provides an air-tight seal against any toxic atmosphere in which a welder might be working. Different shades of filtering lenses can be used, for protection against ultra-violet and infra-red radiation, depending upon whether the acetylene torch or electric arc is used for welding. And finally, the pitting lens can be replaced easily.

A wide angle of vision is afforded by the new face-piece. In particular, an 81° lateral angle of vision is possible with the face-piece, compared with only a 60½° angle with the standard welding shield, while a 37° vertical angle of vision is provided against a 30° angle in the welding shield.

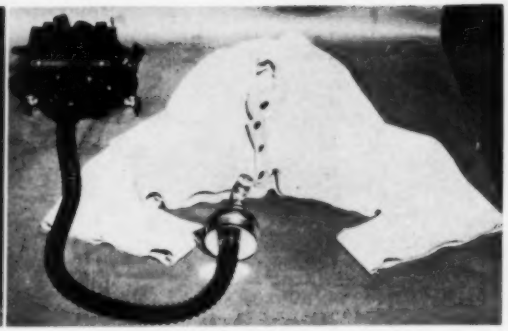
In actual use, the new face-piece furnishes the welder with complete eye, face and respiratory protection. When connected with an approved hose mask, the incoming air stream enters the mask at chin level and is directed against the lens window to prevent fogging. Two spent air outlets at jaw level direct the air-stream about the interior of the hood. Further, the flip-font can be flipped open to permit inspection of the work.

The face-piece was designed so that the wearer would be comfortable and, at the same time, be protected against inhalation and radiation hazards. The unit weighs only eight ounces more than the standard welding shield. However, this is partly offset by improved weight distribution through the head and face supports and by a decrease in the distance of protrusion of the lift front holder.

Besides protecting the worker, the face-piece has been found to save considerable expense when repairs of various facilities are involved, without



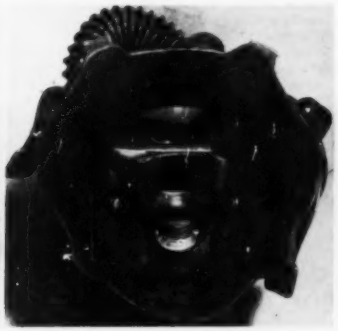
The welder's face-piece is available for three completely different masks. Above, the face piece assembly is shown with a model S all-service canister (to be used outside of tanks), the entire unit consisting of the face-piece, corrugated tubing, the canister, vover lenses and chrome leather hood.



In the photo above is shown the new welder's face-piece assembly for airline respirator (to be used outside of tanks). The unit, as pictured, includes face-piece, corrugated tubing, cartridge filter, and flow control valve for 5-16-inch diameter air hose, welding and cover lenses and chrome leather hood.

Photograph of the welder's face-piece reproduced above is how it looks with flip front open. This shows the safety glass window in face-piece and the back of filter lens.

Side view of the welder's face-piece is pictured above. This view shows the complete flip front open and slot for removal or insertion of pitting lens and filter lens.



Back view of welder's face-piece showing deflector which directs the incoming air onto thes afety glass window. This air direction eliminates fogging and controls distribution.

the necessity of completely cleaning the premises first.

Presently, the welder's face-piece is available for three completely different masks. Parts may also be obtained for the field conversion of Mine Safety Appliance abrasive mask face-pieces. Available combinations are:

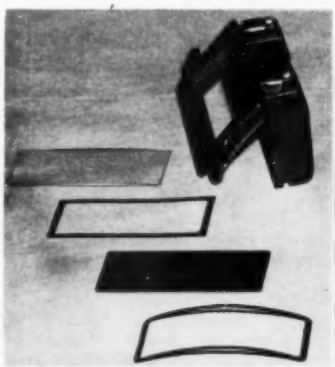
1) Welder's face-piece assembly for combination hose mask; including face-piece, corrugated breathing tubes and Y connections, welding and cover lenses and chrome leather hood.

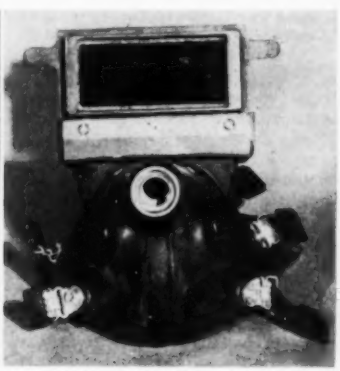
2) Welder's face-piece assembly for airline respirator (to be used outside of tanks); including face-piece, corrugated tubing, cartridge filter, and flow control valve for 5/16-inch diameter air hose, welding and cover lenses and chrome leather hood.

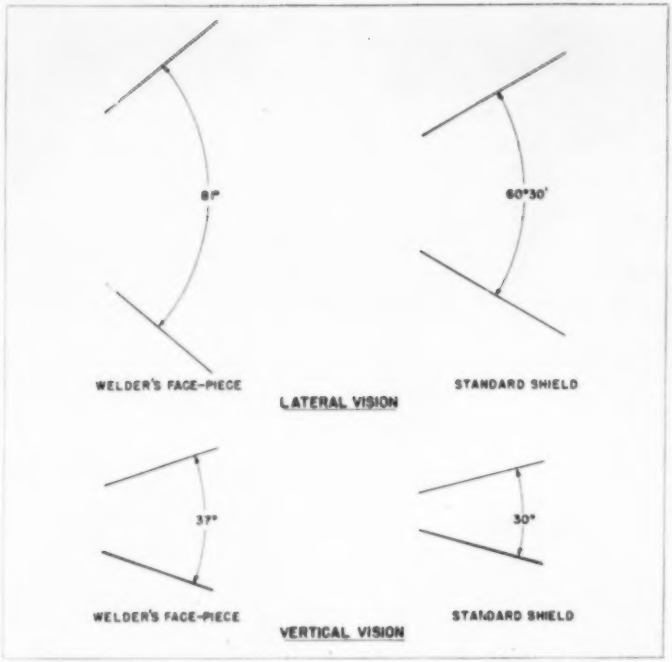
3) Welder's face-piece assembly; including face-piece, corrugated tubing, Model S all-service canister (to be used outside of tank), cover lenses and chrome leather hood.

Below, left—This picture shows the aluminum lift front lens holder of the face-piece, minus the lenses for field conversion of the abrasive mask face-pieces. Parts may be obtained for such conversion.

Right—Flip front open on face-piece showing the back of filter lens and spring which holds filter lens and pitting lens in place.







Comparison of Angles of Vision in Welder's Head-Piece and Standard Welding Shield.

4) Aluminum lift front lens holder only (less lenses for conversion of Mine Safety Appliance abrasive mask face-pieces in the field).

The new welder's face-piece was developed by the author in cooperation with the Safety Department of Ethyl Corporation, and representatives of several oil companies and Mine Safety Appliances Company. Because of long experience with the problems encountered by the petroleum industry in the handling and storing of leaded gasoline, Ethyl's safety department was interested in developing a means whereby, when necessary, gasoline storage tanks might be repaired safely without the necessity for extensive cleaning and preparation of a tank.

The hazards of entering and working in tanks used for the storage of petroleum products, without precautionary measures, arise from the toxic and explosive nature of the vapors, from the presence of tetraethyl lead and its decomposition products in the sludge, dust, rust and scale inside a tank, and from such other contaminants as sulphur dioxide and oxides of nitrogen and, in some cases, hydrogen sulphide.

Before welding could be performed inside such a tank, it was first necessary, prior to the development of this mask, not only to eliminate the explosion hazard, but also to remove the sludge, rust, scale and dust and to free the surface of the metal to be welded or cut of all rust and scale so as to expose the clean metal. In some instances, this required the services of a tank cleaning crew for several days. Even then, it was considered good practice to operate a mechanical ventilator on top of the tank in order to remove fumes during welding.

Full Protection Now

Now, however, all that is required is to gas-free the tank and thus eliminate the possibility of explosion. A welder can work inside such a tank with full protection against all toxic vapors, dust and fumes and against any oxygen deficiency, as long as the new face-piece is used in conjunction with an approved hose mask through which fresh air is supplied. Welding operations have been performed in a small fraction of the time previously required, with a considerable saving in time and money.

Welding repairs become more nearly routine operations when the welder's face-piece is used with a proper mask and in conjunction with mechanical ventilation of the tank. For welding inside a tank, standard practice dictates that an approved hose mask be used to supply fresh air. With this type of mask, even though the blower might fail, the wearer could still obtain fresh air for a time by drawing it with inspirational effort through the 1-inch diameter hose. For exterior repairs, the welder's face-piece may be connected to an airline respirator or a suitable canister-type mask.

One major hazard that should always be guarded against is that in case of a leak in the bottom of the tank, the tank cannot be considered safe for welding until the underlying soil beneath the bottom of the tank has been cleared of volatile materials. Normally, this is done either by flushing the volatile materials and sludge from beneath the tank with water, or by steaming.

While the welder's face-piece was originally designed for use in repairing tanks employed for the storage of petroleum products, it has been found to have numerous other applications. Some years ago, when the face-piece was still undergoing development, it was used in the repair of a 42-inch exhaust line carrying carbon monoxide gas. The work was accomplished without the necessity of closing down the plant, which employed 9200 workmen. Another instance in which the face-piece could be used to advantage would be in repairing a refrigeration system aboard a ship, while a third would involve repairs to say, reaction chambers in an oil refinery. In the third case, when heat is applied to the surface within the chamber, vapors carrying a high sulphur content may be liberated. Such vapors are irritating and dangerous even though the ventilating system on top of the tower is operating. To sum up, the welder's face-piece, it is believed, can be used generally for cutting and welding under conditions devoid of the hazard of explosive vapors.

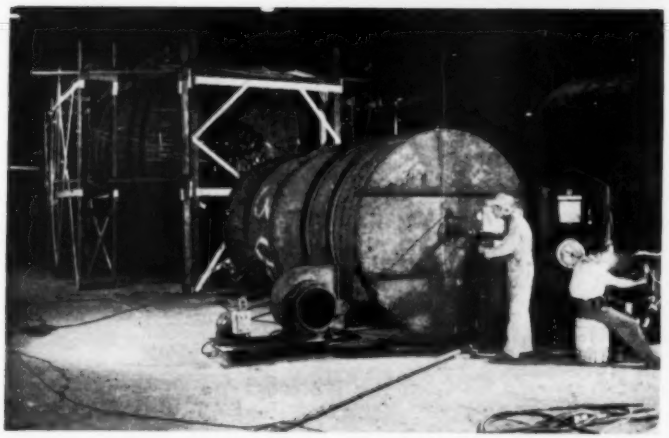
About nine years were spent in developing the face-piece. Many consultations were held with various oil companies, with firms specializing in building gasoline storage tanks, and with manufacturers of safety appliances, as well as with representatives of the U. S. Bureau of Mines. The Mine Safety Appliances Company cooperated with Ethyl Corporation to the extent of manufacturing the various parts of the face-piece as they were developed. The welder's face-piece, in its present form, has been submitted to the U. S. Bureau of Mines for final approval under Schedules 19a and 14e.

The face-piece, as presently constituted, can be obtained from the Mine Safety Appliances Company, in Pittsburgh, although adaptations of it may be made by any manufacturer. The welder's face-piece, it is believed, represents a distinct contribution to safety equipment and should be valuable wherever welding and respiratory protection are required at the same time.

Left: The steel vessel, fabricated in Houston, was too large to ship by rail and wouldn't go in the hold of any cargo ship.

Photo below shows vessel loaded in special low-boy truck it had to be moved across Houston by special permit after midnight. Here it is shown crossing lower Main street.

Steel Vessel Floated in Gulf To Destination

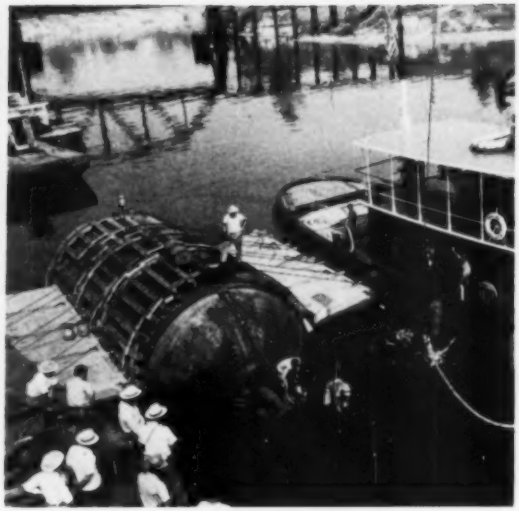


In its manufacture, it was too large for any stress-relieving furnace so heat was blown into it from an especially designed gas furnace shown in foreground at left. A three-inch asbestos covering was put around the vessel to hold the high temperature. Later this was removed.

HOW a huge steel vessel—too large for shipment by rail—was floated through the Gulf of Mexico from Houston, where it was fabricated, to Brownsville, Texas, where it was to be installed is told by the pictures on this page.

Carthage Hydrocol, Inc., through a major engineering construction company, ordered from Wyatt Metal & Boiler Works the vessel which had an outside diameter of 17 feet, was 57 feet, 8 inches long and weighed 284,000 pounds. The wall thickness was 3 inches and the ma-

After the big vessel reached the dock, a giant crane lifted it and dropped it into the waters of the Houston ship channel.



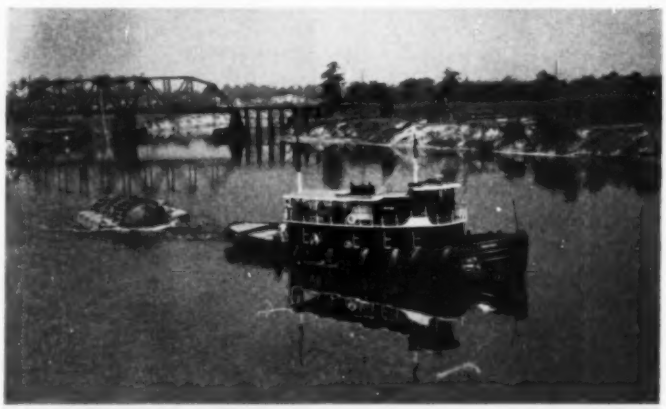
For protection against possible bumps, a dress of heavy timbers was put around it. Pontoons were attached to each side to prevent rolling in the water.

terial used was carbon molybdenum ASTM A-204.

The vessel was too large to go inside any available stress relieving furnace, and Wyatt's plant built a special furnace to stress relieve it by heat induction. A blower system, connected direct to the furnace, blew heat into the vessel over a period sufficient to build up 1200 degrees of heat and hold this temperature for the required period. To facilitate this job, a "dress" of 3-inch thick asbestos was put around the big vessel, and removed after proper heat treatment.

Then came the problem of shipping the vessel to location. It was too large for shipment by rail. It was too large to go in the hold of a cargo ship. But it would float. So it was lowered by giant size crane into the Houston Ship Channel and floated through the Gulf of Mexico, to Brownsville. There it was fished out of the water and skidded to location. A protective covering of timbers made it safe from possible bumping, the latter being put on after the vessel was in the water.

Moving the vessel from Wyatt's plant to the channel wasn't without complications. An oversized "low-boy" trailer was the only conveyance that would take it there. A special moving permit was required from the city of Houston and the trip had to be made after midnight. But the shipping problem was solved, and a second vessel, of the same size, has since reached destination, using the same method of transportation.



Top picture, right: The tug Mohawk towed it down the Houston ship channel, through Galveston Bay and the Gulf of Mexico.

Bottom picture: It was rolled out of the water and to its destination near Brownsville, Texas, several hundreds of miles distance.

EMPIRICAL correlations relating the atmospheric pressure EFV (equilibrium flash vaporization) curve with the TBP (true boiling point) and the ASTM analytical distillation curves are presented in this installment. These charts permit estimating phase conditions for petroleum fractions at atmospheric pressure and form the basis for similar calculations at higher pressures.

Applications of Thermodynamics to Hydrocarbon Processing

PART XXIII—EQUILIBRIUM FLASH VAPORIZATION CORRELATIONS FOR PETROLEUM FRACTIONS

WAYNE C. EDMISTER

Professor, Chemical Engineering

Carnegie Institute of Technology, Pittsburgh

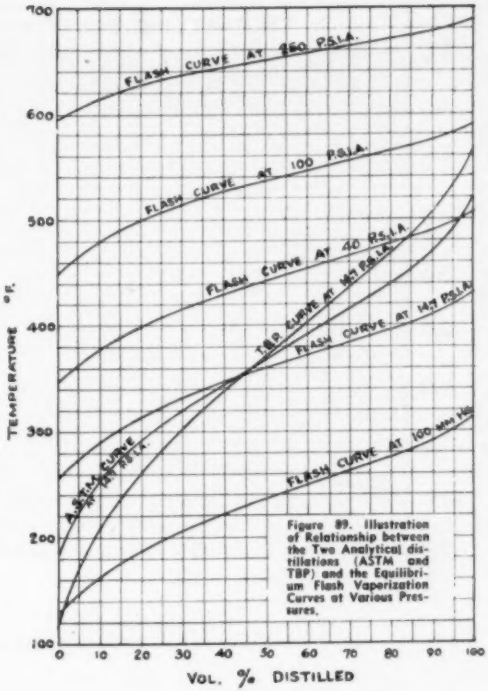

FLASH CURVE AT 250 P.S.I.A.
FLASH CURVE AT 100 P.S.I.A.
FLASH CURVE AT 40 P.S.I.A.
T.B.P. CURVE AT 147 P.S.I.A.
FLASH CURVE AT 147 P.S.I.A.
ASTM CURVE AT 147 P.S.I.A.
FLASH CURVE AT 100 MM HG.
TEMPERATURE °F.
VOL. % DISTILLED

Figure 89. Illustration of Relationship between the Two Analytical distillations (ASTM and TBP) and the Equilibrium Flash Vaporization Curves at Various Pressures.

As PREVIOUSLY pointed out (Part XIX, May, 1949, PETROLEUM REFINER), hydrocarbon mixtures may be grouped into three classifications: a) mixtures of a limited number of easily identifiable components, each appearing in an appreciable amount; b) mixtures of substantially infinite number of practically unidentifiable components, which appear in infinitesmally small concentrations; and c) mixtures containing both types of components, i.e. type *a* in the lower boiling range and type *b* in the upper boiling range.

Vapor-liquid phase equilibrium calculations are made differently for each type of mixture. In the previous four installments of this series, vapor-liquid equilibrium prediction methods for type *a* mixture were presented. This approach to multicomponent hydrocarbon equilibrium prediction is sometimes referred to as the *theoretical component* method. In this and the following two installments, the empirical methods used for vapor-liquid predictions of type *b* mixtures will be discussed and working charts presented. Type *c* mixtures may be handled by special applications of the *theoretical* or the *empirical* methods.

Although there is little thermodynamics theory involved in the empirical methods of estimating phase conditions for petroleum fractions, this subject is of great importance to engineers engaged in petroleum processing work. Accordingly, workable scale graphs will be presented in these installments for the application of this method to actual commercial problems.

In this presentation of the empirical method, the recently published work of Edmister and Pollock[3] will be used rather extensively. The small scale charts in the Edmister-Pollock article will be reproduced on larger scales with more detailed grids in the coordinates. Additional charts for estimating the properties of the equilibrium vapor and liquid from flash vaporization will also be presented.

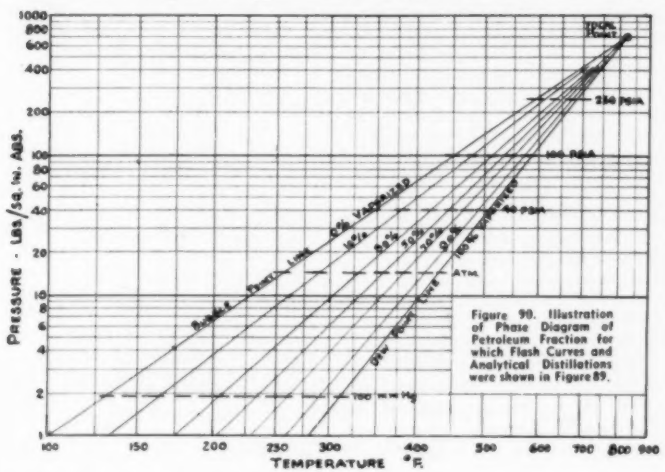


Figure 90. Illustration of Phase Diagram of Petroleum Fraction for which Flash Curves and Analytical Distillations were shown in Figure 89.

Equilibrium Flash Vaporization

The operation known as "equilibrium flash vaporization" (or occasionally as "pipe still distillation") in-

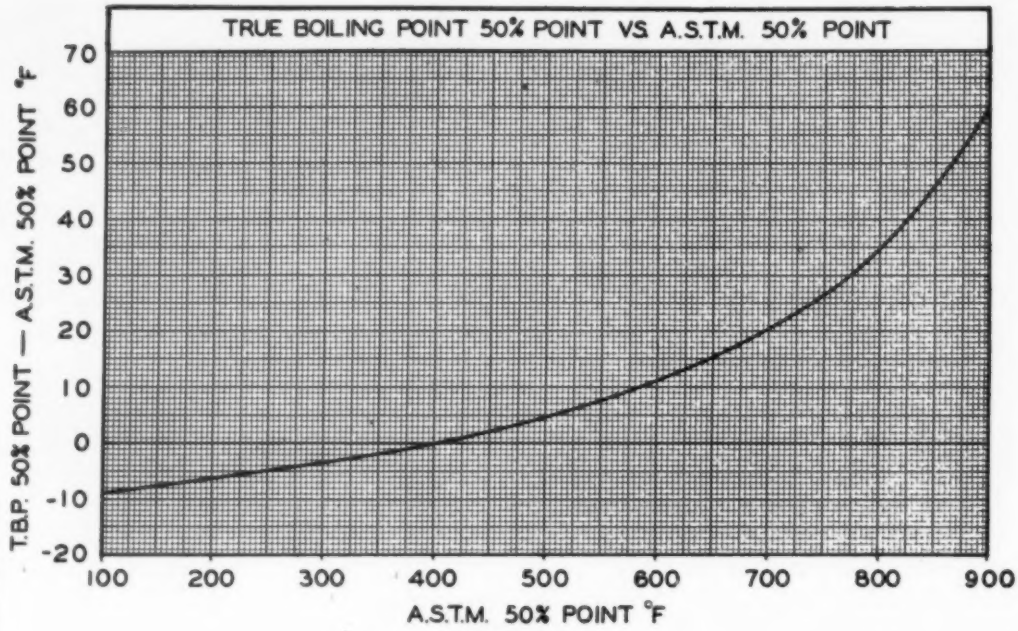


FIGURE 91

volves the separation of a given fluid into a vapor and a liquid which are in equilibrium with each other at the temperature and pressure conditions at which the flashing occurred. If the fluid being flashed is a pure compound, the equilibrium vapor and liquid will have identical compositions at all flashing conditions. If, on the other hand, the fluid being flashed is a multicomponent mixture such as a petroleum fraction, the compositions of the equilibrium vapor and liquid will be different and will vary with the flashing conditions. The limits of this equilibrium flash vaporization operation are the *bubble* and the *dew* points of the charge material.

At the bubble point a fluid is in the liquid phase at the point of incipient vaporization so that an infinitesimal increase in temperature or decrease in pressure will start vaporization. When at its dew point, a fluid is in the vapor phase at the point of incipient condensation so that an infinitesimal decrease in temperature or increase in pressure will start liquefaction. The bubble and dew points for a multicomponent hydrocarbon mixture occur at different temperatures for a given pressure; the wider boiling the mixture the greater the difference between the bubble and dew points. On a pressure versus temperature plot for a multicomponent system, the bubble point line is the zero percent vaporized line, while the dew point line is the 100 percent vaporized line. For a single component, these two lines coincide to give the vapor pressure curve.

Literally interpreted, the term "equilibrium flash vaporization" pertains to the partial vaporization of a mixture or a petroleum fraction by flashing in a continuous system where the vapor and liquid are separated in an equilibrium manner, such as using the equilibrium separator shown in Figure 79 in Part XXI. For any mixture, the relative amounts of vapor and liquid from a series of such equilibrium flash vaporizations will vary with the temperature and pressure conditions under which the separations are made. For the same percent vaporized, the compositions of the equilibrium vapor and liquid vary with the conditions. The properties of the equilibrium products will be taken up in a later installment, however. In this chapter the relative amounts of equilibrium vapor and liquid for atmospheric pressure flash vaporization are of primary interest.

The results of several equilibirum flash vaporization runs on the same mixture and at the same pressure may be plotted to form a smooth and continuous curve of temperature versus percent off. Curves of this kind are called "EFV Curves" and may be prepared for any pressure although atmospheric is the usual pressure employed.

In Figure 89 the EFV curves are plotted for a given petroleum fraction at five different pressures. These same EFV data are plotted in another way in Figure 90. These two plots illustrate the effects of pressure and vacuum on the flash curve, which will be discussed in more detail later, as well as the relationship between the EFV curve and the ASTM and the TBP curves, at the same pressure. The three distillation curves (i.e. TBP, ASTM, EFV) have the same shape, the principal difference being in the slopes. All three curves cross in a manner similar to the illustration in Figure 89. However, the points of crossing vary, depending upon the properties of the fraction involved.

Although the results of these distillations look similar when plotted on the scales used in Figure 89, there are important and fundamental differences that should be clearly understood. The ASTM and TBP curves are from batch analytical distillations of a fixed quantity of the petroleum fraction. These analytical distillations will be discussed further later. The EFV curve, on the other hand, is a plot of a series of flash separations into equilibrium vapor and liquid, each point on the curve representing a single experiment.

Thus the curve designated "Flash Curve at 14.7 psia." in Figure 89 gives the amount that will be flashed to vapor is a continuous equilibrium flash vaporization operation at tempera-

tures from 257° to 430° F. The lower temperature, 257° F., is the bubble point of the fraction, while the higher temperature, 430° F., is the dew point. Between these temperatures the percent vapor from equilibrium flashing will go from 0 percent to 100 percent. At 360° F., for example, 50 percent by liquid volume of the charge will be flashed vaporized.

Flash curves of this kind are frequently determined in the experimental evaluation of a new crude. Such data are of value in designing crude distillation equipment. These equilibrium flash vaporization runs are usually made in small laboratory apparatus, operated in such a way as to simulate the continuous flashing of the oil from the pipe still heater into the flash drum or the bottom section of the fractionator of the commercial unit.

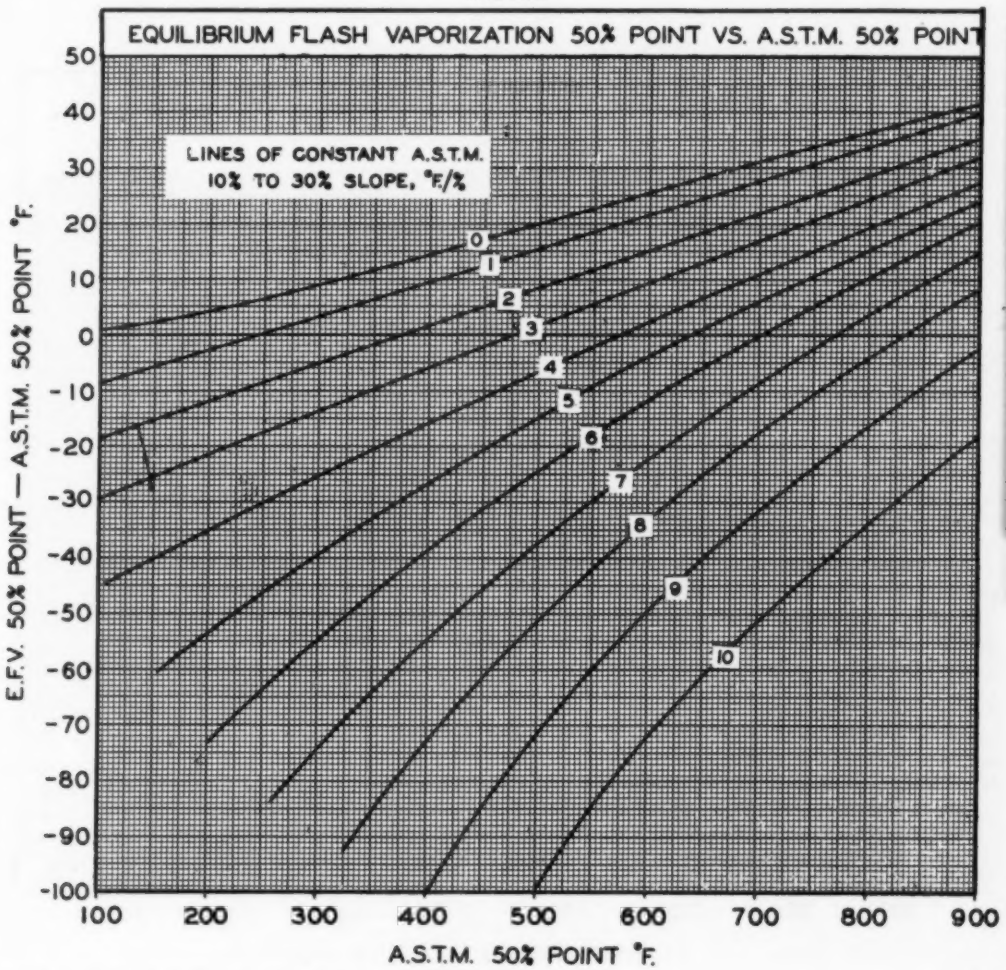
Experimentally determined flash vaporization curves are particularly valuable in designing vacuum distillation units for the separation of reduced crude into the various lube oil cuts. The application of empirical correlations is uncertain in vacuum distillation calculations. For atmospheric and higher pressures, on the other hand, the use of empirical correlations for predicting the EFV curves has proven successful and the practice is rather widespread.

Empirical correlations for predicting the equilibrium flash vaporization conditions are based upon laboratory runs, such as those made in evaluating oils, consistently made so as to cover the entire range of conditions. Because of the close associations with pipe stills, the EFV curves are sometimes called "pipe still distillation curves." Regardless of the name, each of the flash curves, like those shown on Figure 89, represent a series of equilibrium separations.

The relationships that exist between the flash curve and the two analytical distillation curves is purely empirical with no theoretical justification. Nevertheless, very convenient correlations have been developed from this relationship. These correlations are divided into three parts for the prediction of a) atmospheric pressure equilibrium flash vaporization curves, b) effect of pressure on the flash curve, and c) the properties of the equilibrium vapor and liquid.

In spite of its importance and frequent application in the design of pe-

FIGURE 92



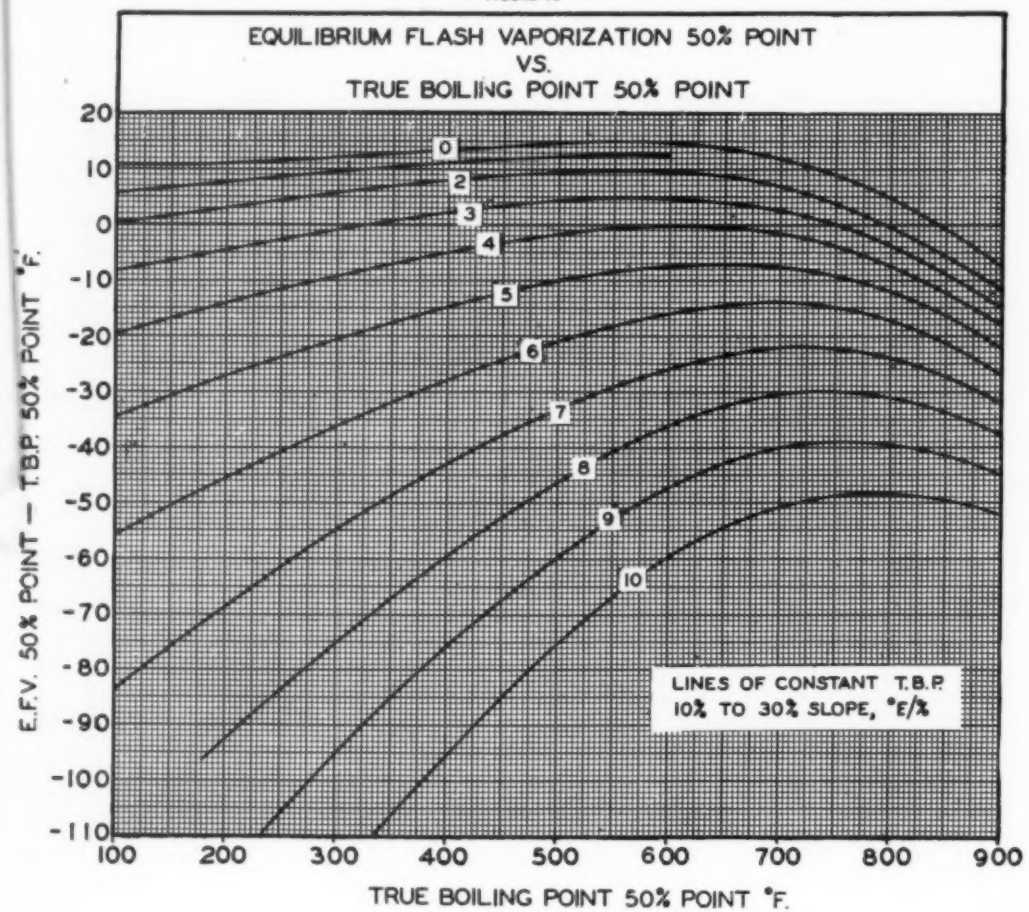
troleum refining equipment, the empirical prediction of phase conditions for petroleum stocks has received very little experimental attention during the past 15 years. Until recently the only available experimental equilibrium flash vaporization data were at atmospheric pressure, there being no experimental data at higher pressures except that of Bahlke and Kay,[2] for which the atmospheric flash curve was not determined. In 1943 Edmister, Reidel and Merwin[3] presented experimental high pressure flash vaporization data for three petroleum fractions. In 1948 Edmister and Pollock[5] presented extensive experimental data at atmospheric and higher pressures plus a complete empirical correlation. A method of estimating the focal point and constructing the phase diagram illustrated in Figure 90 from the atmospheric EFV and the focal point was also developed by Edmister and Pollock. This method will be presented in Part XXIV.

Analytical Distillations

The vaporization characteristics of petroleum fractions are normally defined by the results of one of two standard laboratory distillation operations and such information is necessary for the application of a theoretical or empirical method to the estimation of the phase conditions of multicomponent systems. The two types of standard laboratory distillations available or characterizing petroleum fractions are the ASTM (or Engler) method[1] and the TBP method.[14] The analytical procedures of these two methods are adequately described in the above literature references. The ASTM method approximates true differential distillation, i.e. batch distillation at a uniform rate with no reflux. Adjacent cuts from an ASTM distillation overlap considerably and contain many components in common. On the other hand, a TBP distillation gives a fractional analysis of the individual components in the order of their boiling points with no overlapping of adjacent cuts.

The TBP distillation curve for the lower boiling hydrocarbons, which is determined by the Podbielniak[16] method, is a series of plateaus as a result of the gaps in boiling points of adjacent components. At higher boiling points these gaps disappear due to the occurrence of many isomers, etc., so that the TBP becomes more smooth and continuous. For mixtures in the intermediate boiling range, such as gasoline, the TBP curve starts out as a series of plateaus and gradually changes to a smooth curve as boiling point is increased. In the low temperature range the method of Podbielniak is a widely accepted standard for de-

FIGURE 93



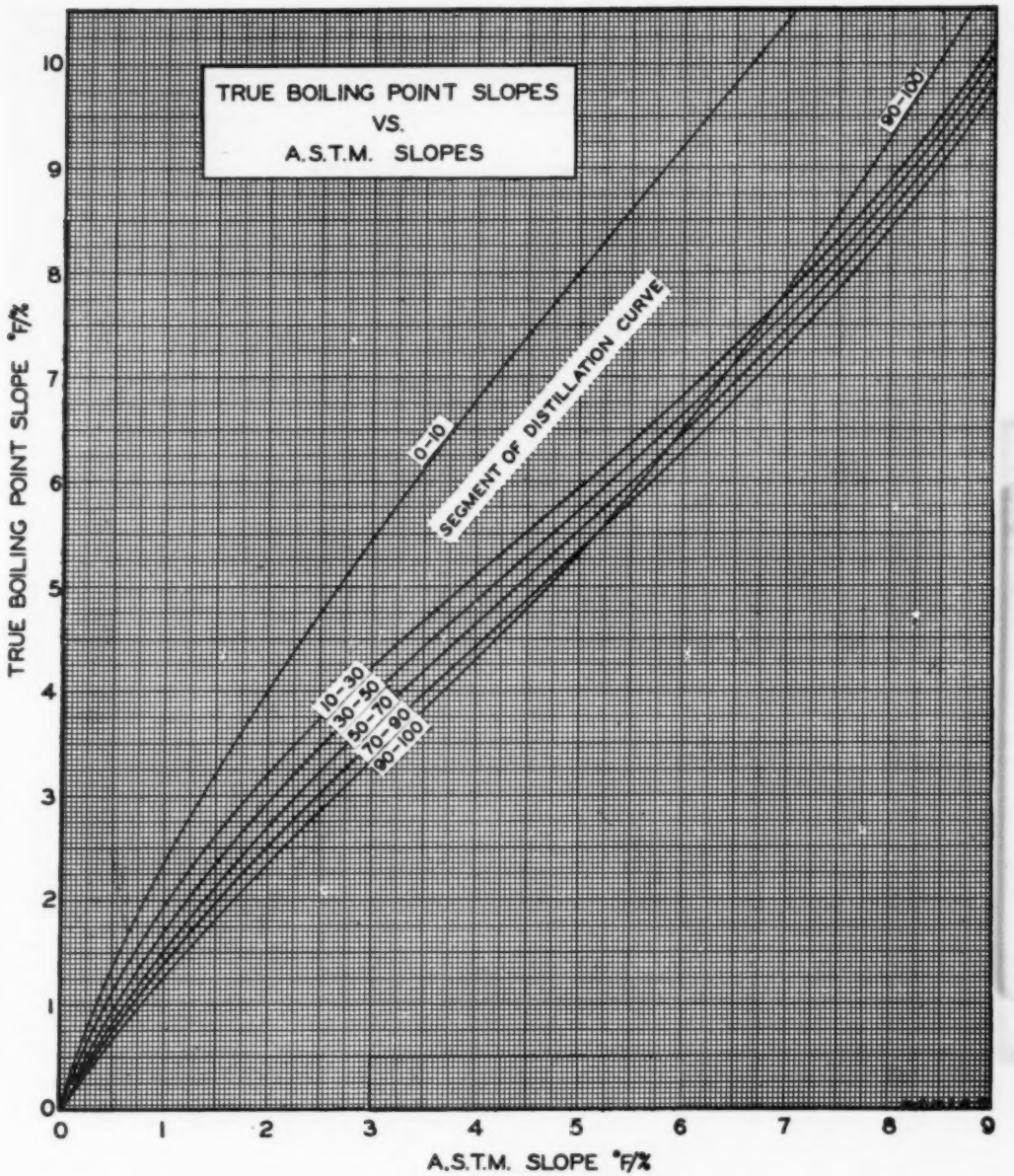


FIGURE 94

termining the TBP or fractional analysis. In the high temperature range a method similar to that proposed by Peters and Baker[14] may be used, although there is no widely accepted standard for high temperature fractional analysis. The high temperature Podbielniak is adequate for hexanes, heptanes and octanes but this is its upper limit.

The ASTM and TBP distillation curves for a typical petroleum stock are plotted on Figure 89 along with the EFV curves at five different pressures. This plot shows the three atmospheric pressure distillation curves (TBP, ASTM, EFV) all crossing and having different slopes, the TBP being the steepest and the EFV being the flattest. These slope and intersection relations hold for all stocks although the points of intersection and the relative slopes may vary for different stocks. It is of interest to note that the steepest of these curves is for the distillation carried out the most slowly in an efficient column with a large quantity of reflux, i.e. the TBP distillation; and that the flattest of these curves is for the distillation carried out spon-

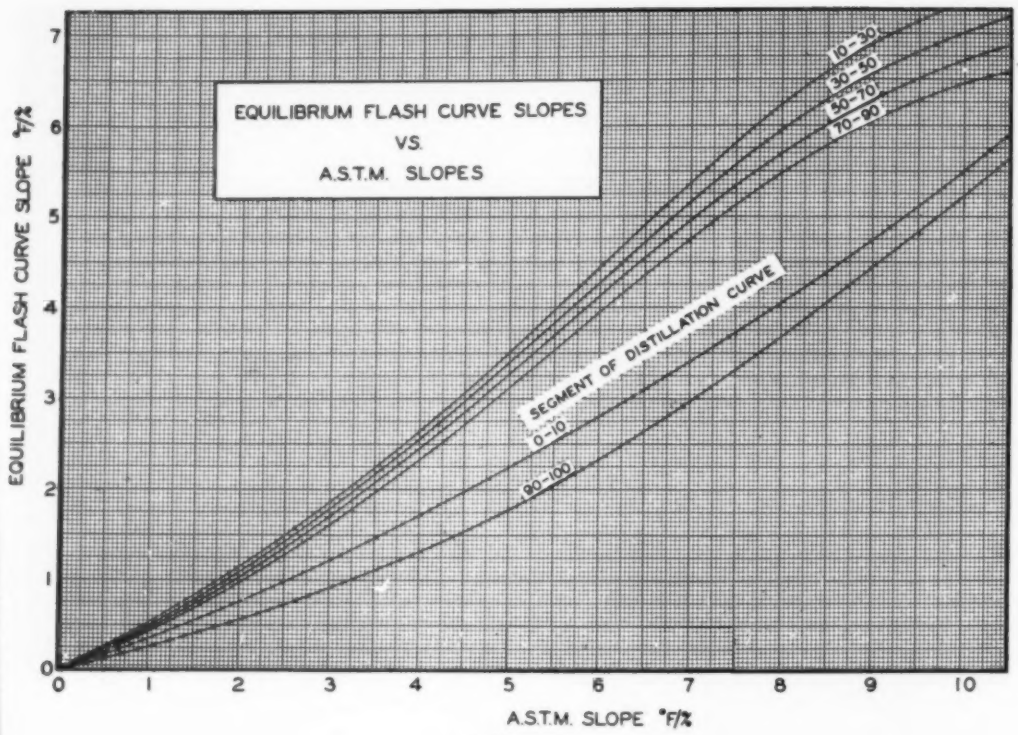


FIGURE 95

taneously with no reflux or plates, i.e. equilibrium flash vaporization.

Although the TBP method of analysis is more definitive with respect to the components present than is the ASTM method, the latter is generally used in preference to the TBP distillation in petroleum refinery process design and plant control work because: a) petroleum products are specified by ASTM standards; and b) the ASTM distillation is simpler and more convenient, requiring about one-tenth the time to run as the TBP. However, the ASTM distillation is inadequate for many problems and must be supplemented by the TBP distillation. Such problems often occur in crude evaluation work and process design calculations involving multicomponent mixtures containing high boiling components.

For these reasons it is desirable to have correlations based on each analysis, ASTM and TBP, so that both the *theoretical* and the *empirical* methods of making phase condition calculations may be used.

Experimental Basis for Correlations

The empirical correlations presented in this installment as Figures 91 through 96 were based on experimental data from various sources, as indicated by Edmister and Pollock.[8] Most of these data were only partially complete, i.e. data on only two of the three curves, which made it necessary to develop simultaneously correlations relating ASTM, TBP and EFV each with the other, thus giving three correlations in all.

Some of the information available in the literature gave ASTM and TBP distillations on the same stocks, but no EFV curves. Others gave ASTM and EFV data only, while others gave TBP and EFV data only. Some authors gave all three distillation curves on the same stocks. All of this information was used in the development of the correlations presented. The sources of the data used are given in the literature references.[2, 4, 5, 6, 10, 11, 12, 15]

Geddes[6] presented ASTM vs TBP data on 58 stocks plus an empirical correlation for going from the TBP to the ASTM, and vice versa with trial and error procedure. Nelson and Hansburg[10] presented ASTM and TBP distillation data on 10 stocks and a correlation relating the two distillation curves. Peters[15] presented TBP vs EFV data on 15 stocks. Piroomov and Beiswenger[15] obtained all three (ASTM, TBP, EFV) distillation curves on 20 stocks. Fancher[5] obtained ASTM and EFV curves for four stocks. Edmister and Pollock[3] presented ASTM vs EFV data on 26 stocks, ASTM vs TBP data on six stocks and all three distillation curves for one stock. Edmister, Reidel and Merwin[4] obtained ASTM vs EFV data on three stocks.

The correlations presented here were based on all of the above mentioned data except the last reference because the correlations were completed before the latter data were available. (Note: Edmister and Pollock completed their manuscript in 1941 but it was not published until 1948). The correlations were checked with the Edmister, Reidel and Merwin data, however, with good agreement.

The apparatus used in obtaining the experimental data presented in these two articles, co-authored by this writer, were described in those papers and their references. One apparatus was a small laboratory equilibrium still similar to the ones used by Leslie and Good,[9] by Piroomov and Beiswenger[15] and by Fancher[5] in their experimental work. This type of apparatus was satisfactory for atmospheric pressure but not for higher pressures or for vacuum experiments. Apparatus

for vacuum and for high-pressure experiments must be constructed to operate at the different pressures. However, vacuum and pressure apparatus may be operated at atmospheric pressure.

The high-pressure apparatus employed by the writer and collaborators was of pilot plant scale (one to five gallons per hour of charge) and operated at varying pressures from atmospheric up to 200 psig. Thus, atmospheric pressure EFV data were obtained from the same apparatus used to get the high-pressure EFV data. This overlapping helped to tie the different parts of the correlation together more consistently.

Atmospheric Pressure Correlations

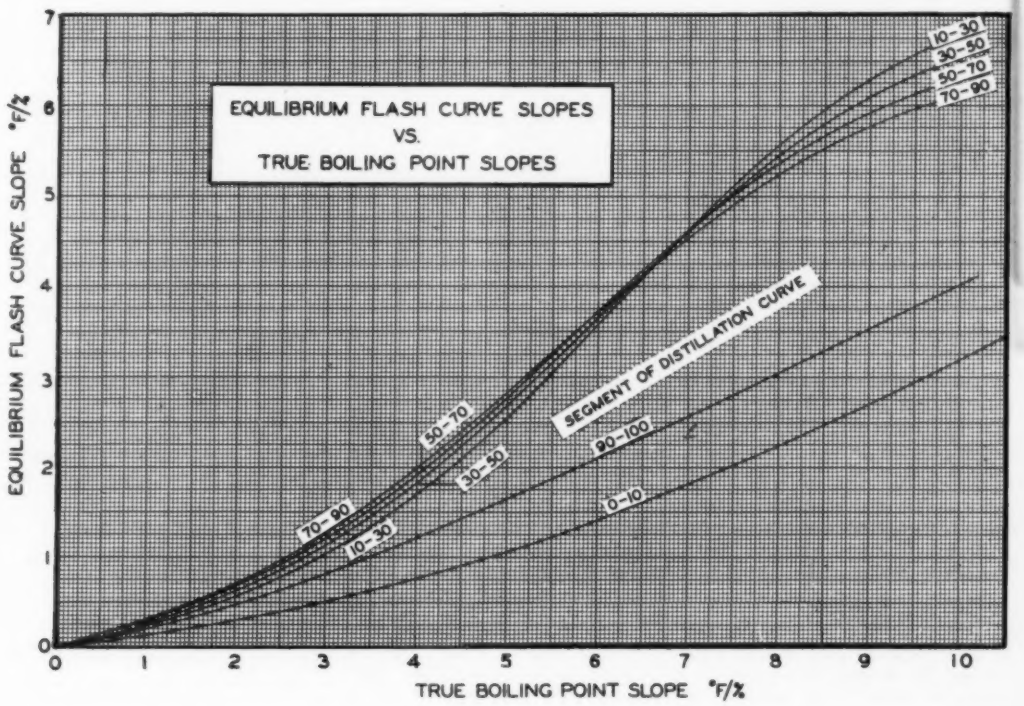
In petroleum process design work it is frequently necessary to start with one of the two analytical distillation curves (i.e. ASTM or TBP) and predict the other or the EFV curve. For this reason it is desirable to have a three-way correlation relating these three distillation curves. Preparing the required three correlations, which are presented here as Figures 91 through 96 simultaneously made the correlations as consistent as possible and also took full advantage of the data available.

There are two types of empirical correlations available in the literature for predicting the EFV curve at atmospheric pressure. In the method proposed 20 years ago by Piroomov and Beiswenger[15] the flash curve was assumed to be a straight line and predicted by estimating the point at which it intersects the ASTM or the TBP distillation curves and also estimating the flash curve slope from the slope of the ASTM or the TBP curves. In the method proposed by Nelson and Souders[11] and modified by Katz and Brown,[6] the EFV curve was also assumed to be a straight line and predicted by estimating its 50 percent point and slope from the 50 percent point and slope of the ASTM or the TBP distillations. An examination of experimental EFV curves shows that they are not straight although the curvature between the 10 percent and 90 percent points is usually slight. In the method presented by Packie[12] this departure from a straight line was taken into consideration.

In developing a method for predicting the EFV curve from the ASTM or the TBP distillations, a method of going from the ASTM to the TBP curve is indirectly obtained because any two of these correlations fixes the third. As mentioned above these three correlations were developed simultaneously. The resulting three-way correlation relating ASTM, TBP and the atmospheric pressure EFV curves is shown on Figures 91 through 96, Figures 91, 92 and 93 being the 50 percent point relationship and Figures 94, 95 and 96 being the slope relationships.

The 50 percent point was selected as the key point after trying several other points including the 30 percent point and the intersection point. Using the 50 percent point, the results were only slightly better in the ASTM-EFV correlation than when using the 30 percent point. However, the 50 percent point was appreciably better for the ASTM-TBP correlation. The ASTM-TBP 50 percent point correlation, Figure 91, does not involve a slope variable, while the EFV curve 50 percent point correlations, Figures 92 and 93 require this parameter. Various slopes were tried before the 10 percent to 30 percent slopes were selected. The 10-30 percent slopes not only give better accuracy but they are more practical because they are most always available even for heavier stocks for

FIGURE 96



which the 10-70 percent and the 10-90 percent slopes would be unobtainable without extrapolation.

The slopes of the three atmospheric pressure distillation curves were correlated by segments, the curves being divided into six parts. The portion of the distillation curves between 10 percent and 90 percent off was divided into four 20 percent segments in developing these slope correlations, i.e. Figures 94, 95 and 96. Although the data scatter badly, especially for the 0-10 percent and the 90-100 percent segments, there is definite evidence that the curves should be divided in this manner. By plotting the three sets of data simultaneously, it was possible to determine these slope relationships with the available data. The resulting slope relationships hold over these 20 percent ranges and may be applied to any portion of the particular segment involved. In the estimation of the 20, 40, 60 and 80-percent points, as well as the 10, 30, 50, 70 and 90-percent points, the calculation would be made with 10-percent increments rather than 20 percent. The slope relationships given may be used for any calculation involving increments of 20 percent or less.

In developing these atmospheric pressure correlations, it was necessary to compromise the data in a few instances in order to make the correlations consistent. However, as pointed out above, the plotting of all three correlations simultaneously permitted making full use of the available data. This plus the consistency appear to justify the compromises in the data that were necessary. Where possible, this compromising was done to the TBP-EFV correlation because fewer data were available for this relation and it is less frequently used than the other correlations. The average deviations for the 50-percent point correlations, Figures 91 to 93, are about ±7° F. for the ASTM-TBP correlation, about ±9° F. for the ASTM-EFV correlation, and about ±13° F. for the TBP-EFV correlation. The average deviation for the prediction of the 30 percent points, involving slope correlations, Figures 94 to 96, is about the same as for the 50 percent points, whereas the average deviations for the predicted 70 percent points are about one degree more.

Example

As an illustration of the application of the correlations given in Figures 91 through 96, the equilibrium flash vaporization curve will be estimated for the stabilized gasoline having the following properties:

°API Gravity	ASTM DISTILLATION (Corrected for Loss)										
	Initial	10	20	30	40	50	60	70	80	90	FBP
61.6	63° F.	117	156	186	213	239	262	287	312	342	400° F.

The calculations involved in determining the atmospheric equilibrium flash vaporization curve from the ASTM distillation data are summarized in Table 56. Referring to Table 56: The ASTM distillation points used in the calculations are tabulated in column 2. In columns 3 and 4 are tabulated the differences between the indicated points on the ASTM distillation curve and the corresponding slopes. From the ASTM 50-percent point, 239° F., and the ASTM 10-30-percent slope, 3.5° F./%, the EFV 50-percent point is found to be 214° F. (239 — 25 = 214) from Figure 92.

The EFV curve slope for the various segments of the distillation curve corresponding to the ASTM slopes given are determined from Figure 95 and are tabulated in column 5 with the corresponding differences in column 6. In making these slope readings, the 20 percent segment curves on Figure 95 were used to read the 10 percent slopes, for example; from the 10-30 curve the 10-20 percent and the 20-30 percent slopes were found. The EFV curve points in column 7 are determined by subtracting from and adding to the EFV 50 percent point the difference given in column 6.

The effect of pressure on the EFV curve will be given in Part XXIV to appear in an early issue.

TABLE 56

Sample Calculation of Atmospheric Pressure EFV Curve of Petroleum Fraction from ASTM Data

Volume Percent Off	ASTM			EFV		
	Temperature °F.	Difference °F.	Slope °F./%	Slope °F./%	Difference °F.	Temperature °F.
0	63					114
		54	5.4	2.5	25	
10	117					139
		39	3.9	2.5	25	
20	156					164
		30	3.0	1.9	19	
30	186					183
		27	2.7	1.6	16	
40	213					199
		26	2.6	1.5	15	
50	239					214
		23	2.3	1.2	12	
60	262					226
		25	2.5	1.3	13	
70	287					239
		25	2.5	1.3	13	
80	312					252
		30	3.0	1.6	16	
90	342					268
		55	5.5	2.2	22	
100	400					290

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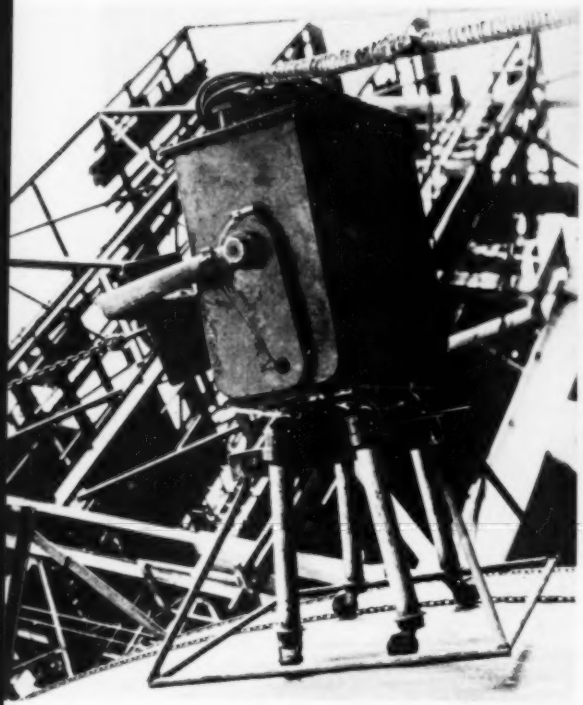
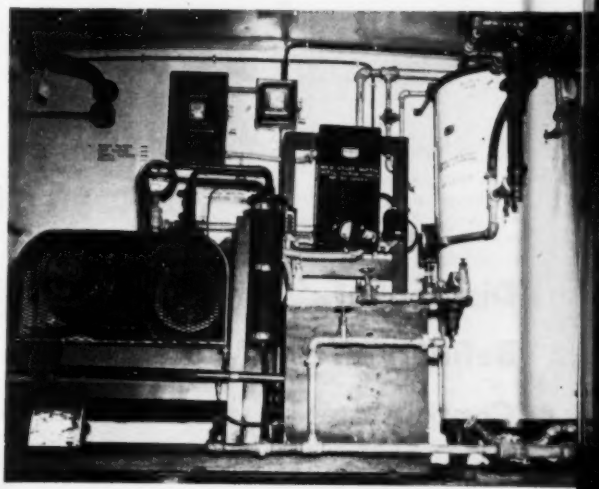
Mobile Units Used to X-Ray Field Equipment And Piping



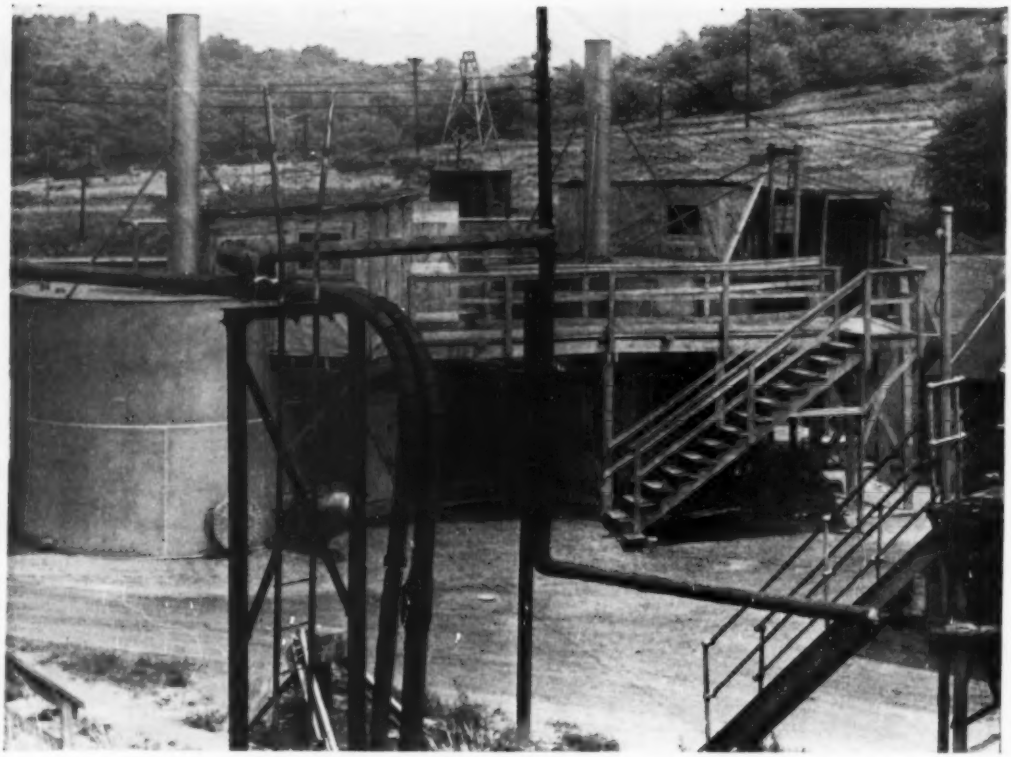


The M. W. Kellogg Company's postwar, mobile radiography units are used to make X-rays of field fabricated equipment and piping. The units permit these chemical refinery engineers of Jersey City, to make any required X-ray inspections in the field, easily and relatively inexpensively. Each trailer includes the dark-room equipment needed to process the negative plus space for the transporting radiography units. Arriving on a site, all that is needed to bring in and connect a one-inch water line, put in a drain and then hook into a power line. Note photo at top of page.

Photo at lower left shows the field radiography X-ray unit being used to check seams on a field fabricated pressure vessel in an oil refinery. Essentially medical equipment (250 kvp. converted for industrial use), this unit enables study of virtually all welded seams in large diameter vessels and piping. For smaller pieces or inaccessible areas, radium capsules are used. Field radiography has several familiar advantages such as permitting higher joint efficiency and insuring early elimination of sub-standard welders.

Interior view of front end of trailer, photo on lower right, shows two-stage refrigerating unit and water storage tanks. Radiography units are also stored here safely in transit.

The center section of the trailer is used as an examination for studying films, while the after portion contains developing tanks, sinks, cabinets for supplies, the air conditioning unit and electrical heating equipment. Employment of such a trailer precludes the necessity of a specially constructed temporary building from which to operate.



Waste Water Disposal Plant as Described in First Part of Accompanying Article.

Disposal of Refinery Waste Water Containing Water-Soluble Sulfonates

HANS SCHINDLER
Sonneborn Sons, Inc., Daughtery Refinery, Petrolia, Pa.

***DESCRIBED** here is a process which in its basic form has been in actual operation for nearly two years. Although designed expressly to treat waste water containing water-soluble sulfonates, it is believed the process will be of interest to all refiners whose operations include the reaction of sulfuric acid with petroleum hydrocarbons under conditions which can lead to the formation of water-soluble sulfonation products. The particular process outlined has been found satisfactory both with respect to ease of operation and treating expense.*

WHILE satisfactory procedures and equipment are available for the separation of unemulsified oil from refinery waste water—thanks to the continued efforts of the Committee on Disposal of Refinery Waste of the American Petroleum Institute—no specific procedure has been adopted or even brought up for discussion by the industry for the disposal of water containing water-soluble refinery waste. This is quite understandable since this problem is complicated by variations in type and concentration of the waste products originating at different refineries, factors which are absent in the case of the purely physical separation of oil and water.

However, when the soluble wastes are grouped according to the refinery process from which they originate, it is possible to develop waste water treating methods which are applicable throughout each group although some modifications will doubtless be required from one plant to the next. It is in accordance with this thought that a process for the treating of waste water

containing water-soluble sulfonates is described.

Treating Procedure

Before discussing details of the treating procedure, it will be necessary to consider the nature of the waste products and to outline the scope of the treating method. Reaction of concentrated sulfuric acid and especially oleum with petroleum distillates leads to the formation of sulfonation products of alkylated aromatics which, depending on structure and molecular weight, are soluble in water and/or oil. The bulk of the oil-insoluble, water-soluble sulfonates together with the spent acid separates from the treated oil in the form of sludge and efficient methods are available to dispose of this sludge by conversion into sulfuric acid and coke. However, unavoidable spills, periodic cleaning of equipment and the purification process for oil-soluble petroleum sulfonates lead at times to the presence of water-soluble sulfonates in the waste water originating at the units concerned with these operations.

According to its source, this type of waste water is either acid or alkaline, contains dissolved sulfonic acids and sometimes emulsified oil and is of dark color. Successful treatment therefore, must accomplish 1) proper adjustment of pH, 2) reduction of color 3) substantial removal of oil. It has been found that all of these aims can be achieved by acidifying the waste water in case it is alkaline and precipitating the major portion of the sulfonates with lime, combining this procedure with flocculation by means of ferrous sulfate should the addition of lime not be sufficient to achieve the desired degree of color reduction. The treated water after settling can be discharged into the stream.

Details of Treating Procedure

As is evident, the treating procedure consists basically in precipitation of the sulfonic acids as insoluble calcium salts and removal of additional coloring matter by adsorption on an iron hydroxide floc. The lime precipitate is a good adsorbent for oil and effectively removes the oil present in the waste water; for the purpose of removal of oil no additional floc is required.

In order to obtain optimum decolorizing action and settling in case that ferrous sulfate treatment is required, the water should be brought with lime to pH 10 prior to the addition of ferrous sulfate. The final pH of the treated water, regardless whether only lime or lime and ferrous sulfate is used, should be 8.4 since optimum settling is obtained under these conditions. The treating procedure can be summarized as follows:

1) Adjustment of waste water to pH 5.
2) Addition of hydrated lime and adjustment of pH to 8.
3) In case decolorization and settling is found poor in step 2), adjustment of pH to 10, followed by addition of ferrous sulfate.
4) Settling of the precipitate.
5) Release of settled water at a controlled rate.

Plant Operations

The treating procedure has been in actual operation at the Daugherty Refinery, Petrolia, Pa., for almost two years during which time an average of 850,000 gallons of waste water were treated per month. However, it should be emphasized that in spite of the volume handled the system must be considered as experimental and has been used to obtain information for the design of an improved treating system which has been submitted for approval to the state authorities.

According to its nature, the experimental treating plant is only semi-continuous and no special provisions have been made for mechanical handling of the treating chemicals which are added in the solid state. Treating is carried out in two 14,000-gallon tanks, each equipped with a 10-hp. direct drive side entering propeller mixer. Acid can be introduced into the tanks through a 10-gallon measuring container connected to one of the plant acid storage tanks. The tanks are charged by gravity from one of two waste water storage tanks to which the water is pumped from two concrete pits into which special sewer systems empty. The treated water is pumped to a settling basin from which it is released at a controlled rate.

Results obtained with waste water of average composition and also with water of an unusually high concentration of water soluble sulfonic acids are shown in Table 1.

It is evident from the data listed that the treatment is rather successful in reducing the color of the waste water and its oil content. The treating results given refer to the properties of each batch treated and are not identical with the properties of the water actually discharged to the stream.

Comparison of the efficiency of ferrous sulfate, purchased as commercial copperas, and aluminum sulfate showed that the use of the latter is less advantageous since larger quantities are required—on a pound per pound basis—to obtain the same degree of decolorization. In addition, the total amount of lime consumed in the treating process is higher with aluminum sulfate, due to the necessity of neutralizing the acid formed by hydrolysis. These two factors combine to make the use of this chemical less attractive economically.

Improved Treating Procedure

While the color removal effected by the treating procedure is quite considerable, further improvements in the quality of the effluent were found feasible. These can be achieved by blending the waste water which contains soluble sulfonates with water containing 0.1-0.2 percent H_2SO_4 but is otherwise free from contaminating waste and treating the blend with lime. The acidic water is produced continuously at a uniform rate by the acid sludge conversion plant which forms part of the refinery. Since the acidic water supply is constant while the flow of the refinery waste varies considerably during the day it is best to accumulate the latter and blend it continuously at a predetermined rate with the acidic water. The optimum ratio for the waste water under consideration was found to be 85 percent acidic waste and 15 percent waste water.

Desirable Distillation

This mode of operation provides not only a convenient source of acid for the acidification of the refinery waste water—a prerequisite for efficient color removal by lime treatment—but also dilutes this portion of the waste in a highly desirable manner. Consequently, the necessity for ferrous sulfate treatment is almost completely eliminated and need only be practiced in the case of waste water containing

TABLE 1

Treating Results on Waste Water Containing Sulfonic Acids

SAMPLE No.	TREATMENT LB./10,000 GALLONS			COLOR (PPM)*		O_2 CONSUMED (PPM)**		OIL (PPM)	
	Sulfuric Acid	Lime	Ferrous Sulfate	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
1		900	140	10,000	150	151.2	47	40	5
2		450	120	4,000	125	364.8	50	25	Trace
3	320	330	108	1,250	40	307.0	47	4,625	50
4	200	360	160	1,500	60	537.0	63	5,480	54

* K_2PtCl_6,$CoCl_2$ standards. ** Cold.

TABLE 2
Improved Waste Water Treatment

Date of Sampling	Composition of Sample	Treatment Lb. Lime 10,000 Gallons	Oxygen Consumed ppm	Color ppm
7/7	A.P.S.*	None	45.4	30
	W.O.**	None	307.0	1,250
	Blend, 85% A.P.S., 15% W.O.	None	34.8	500
	Same	220	21.8	20
7/8	W.O.	None	537.0	1,500
	85% A.P.S., 15% W.O.	None	105.8	250
	Same	218	33.6	30
7/9	W.O.	None	324.0	6,000
	85% A.P.S., 15% W.O.	None	109.2	1,000
	Same	220	28.8	50
7/10	W.O.	None	465.0	1,000
	85% A.P.S., 15% W.O.	None	13.4	250
	Same	187	10.0	10
7/11	W.O.	None	440.0	3,000
	85% A.P.S., 15% W.O.	None	15.1	750
	Same	208	8.4	30
7/12	W.O.	None	141.0	2,000
	85% A.P.S., 15% W.O.	None	23.0	250
	Same	215	19.2	40
7/14	W.O.	None	332.0	1,000
	85% A.P.S., 15% W.O.	None	28.8	125
	Same	210	13.4	30
7/15	W.O.	None	1,070.0	8,000
	85% A.P.S., 15% W.O.	None	132.5	1,000
	Same	220	74.9	55
Average	100% W.O.	None	452.0	2,970
	85% A.P.S., 15% W.O.	None	57.8[1]	513[3]
	Same	212	26.1[2]	32[4]

* Acid plant scrubber water. ** White oil plant waste water.
[1] 87.2% reduction. [2] 94.2% reduction [3] 82.7% reduction. [4] 98.9% reduction.

a high concentration of soluble sulfonates. If ferrous sulfate treatment is found necessary, it is applied as pretreatment.

It was not possible to carry out experimental work on the improved procedure on plant scale but the experience gained with the original treating method together with exhaustive laboratory studies leave no doubt as to the performance of the process. The data in the following table illustrate the performance of the improved process. A settling time of 40 minutes was found sufficient in all cases to give a clear effluent, provided a pH of 8.4 is maintained. Longer settling times are required at lower pH values.

It is evident from these data that the properties of the effluent from the improved treatment are highly satisfactory. The advantages of this type of treatment can be summarized as follows:

1) Replacement of fresh acid by an acidic waste water requiring treatment (neutralization) prior to discharge.

2) Simplification of chemical treatment. Only lime is needed as treating chemical and the use of a flocculent like ferrous sulfate is limited to special cases.

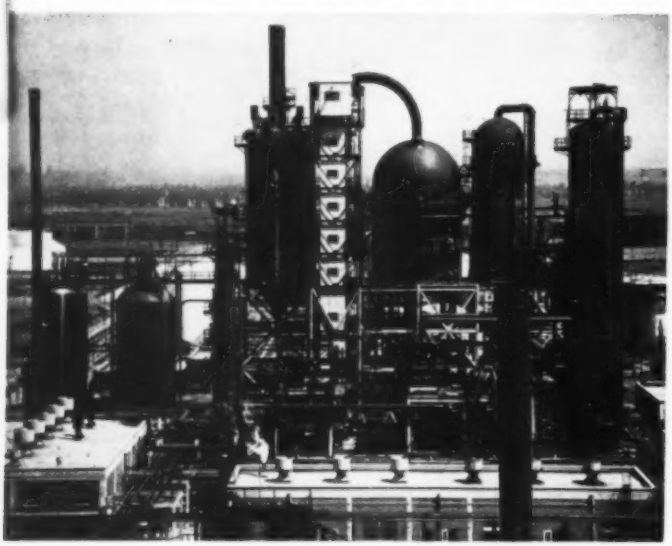
3) Dilution of the waste water containing dissolved sulfonates with a considerable volume of acidic water free from other contaminating waste.

In case that no clean acidic waste water is available, equally good results as to color removal can be obtained by diluting the waste water *prior* to treatment with fresh water and then proceeding with acidification and lime treatment. The reduction in color obtained in this way is considerably greater than that resulting from treating the concentrated waste water and diluting it prior to releasing it into the stream.

A complete waste water disposal system for the Daugherty Refinery based on the improved treating procedure has been designed by the engineering firm of Morris Knowles, Inc., Pittsburgh, and is presently under construction. This plant will handle daily about 180,000 gallons of acidic water and an average of 35,000 gallons of waste water as well as up to 70,000 gallons of storm water.

* * *

Cities Service Completes Expansion at East Chicago, Ind., Refinery



Cities Service Oil Co. (Delaware) has completed at its East Chicago, Ind., refinery a modernization and expansion program which included two major process facilities—a fluid catalytic cracking unit with gas recovery plant and a delayed coking unit.

The "cat" cracker, shown at left, has a rated capacity of 14,760 barrels of feed stock per day, while the delayed coking unit is capable of producing 326 tons of high-grade petroleum coke daily.

Minor processing units included in the approximately $20 million program include revamped gasoline treating, light ends recovery, gas purification units and a revamped thermal recovery unit.

Auxiliary projects include modernization of the refinery's water and sewer system, installation of equipment for cleaning effluent water, increases in boiler-plant capacity, the construction of several new buildings and additional products and crude oil storage.

Engineering design and construction was by The M. W. Kellogg Co.

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REFINER AUTHORS and Other Personalities

Naturalized Texan From Brooklyn

JOHN W. NEE, Brooklyn-born, is by his own admission a "naturalized Texan" and we gather that he is proud of it. Currently, he is technical director of the Napko Paint and Varnish Works, Houston. His article, "Shop Primers Important to Process Plant Paint Programs," which begins on page 107, is drawn from his extensive experience in specification writing and formulation of coatings for oil refineries and other process plants. He recently presented an article, "Formulation of Corrosion-Resistant Paints" before the Houston Chapter of the National Association of Corrosion Engineers, of which he is a member.

Nee was graduated from New York University and has received a certificate in technical chemistry from Pratt Institute. Since then he has spent 21 years in the protective coating industry. He spent nine years as chief chemist, Varnish Division of Valentine & Company, and later chemist in charge, Metal Division of Roxilin Flexible Finishes, Inc.

Nee is a member of the American Chemical Society and a Fellow of the American Institute of Chemists.

One of his hobbies is painting his own home in his spare time . . . with Napko products.

Down Under Report On Shale Oil Work

GEORGE E. MAPSTONE, of Australia, contributed "Shale Tar Bases as a Gasoline Constituent," which begins on page 111. Mapstone is a second generation New Zealander and was born in Christchurch, New Zealand, in 1917. He was graduated from Canterbury University College, University of New Zealand, with a bachelor of science in 1939, and took top honors when he obtained his master's degree in 1940.

Mapstone joined the National Oil Pty., Ltd., Glen Davis, N.S.W., Australia, as laboratory chemist in early 1941, later was technical assistant to the carbonizing superintendent, assistant chief chemist and since May, 1946, has been chief chemist.

Glen Davis is a township of about 2000 population. It was established in 1938-39 when the company started operations on the shale deposits. It is 20 miles from the railhead, and 52 miles from the nearest "reasonable" shopping center.

Because Glen Davis is so isolated, classes are held for the Sydney Technical College Diploma in Chemical Engineering, covering the first three years of the six-year course of the university. Mapstone is in charge of the classes, which are conducted by the company staff on a part-time basis.

During the war Mapstone and other personnel were called on to advise some of the "backyard" shale oil concerns that sprang up. Some of the "patent" retorts, he writes, were weird and wonderful—"some only the inventor could love."

Since National had to break the ground and derive their own know-how, Mapstone has written and published more than 40 articles, most of which deal with some aspect of shale oil technology.

His four-year-old son claims and, he says, demands much of what time he has off the job.

Aluminum and Amateur Acting

Fred L. Plummer, author of "Use of Aluminum in the Petroleum Industry" (page 97), is director of engineering for the Hammond Iron Works in Warren, Pa. In 1920 he received a bachelor of arts from Ohio University, then a bachelor of science in civil engineering from Case School of Applied Science in 1922, and a master of science in civil engineering from Case in 1924. He is a registered engineer in Ohio and New York.

From 1922-37 he was associate professor of structural engineering of Case Institute of Technology at Cleveland. In addition, he was lecturer at Cleveland School of Architecture of Western Reserve University (1925-37), and a lecturer at John Huntington Polytechnic Institute (1932-40). From 1937 to 1940 he was chief design engineer of the Main Avenue Bridge Projects at Cleveland. He has been director of engineering for Hammond since 1940. Over a 20-year period he has served as consultant or technical advisor for many large corporations.

Plummer is a director of the Conewango Club, a member of the Conewango Valley Country Club, and an elder in the First Presbyterian Church of Warren. He and Mrs. Plummer are the proud par-

Plummer is author of two books, "Statically Indeterminate Structures," 1944, and "Soil Mechanics and Foundations," 1940, by Pitman Publishing Corporation. He also has written and published many technical articles.

His listening hobby is music—operas and symphonies, but for singing he prefers barber shop and men's choral groups. His exercise hobbies include a flower garden with a few prize roses and amateur acting.

Coon Hunter—Writer Safety Engineer

William A. Newman, Ethyl Corporation safety engineer in the Southern Region, at Houston, author of "New Welder's Face Piece Developed for Working in Toxic Atmosphere" (page 138), joined Ethyl Corporation as a field representative a little over 22 years ago. He worked in the Ohio, Kentucky, West Virginia and Tennessee section for 10 years, where he supervised construction of mixing plants at many refineries. He was president of the West Virginia Petroleum Marketers Association for three years, 1935-38.

In 1938 he became manager of the Ethyl Automotive Clinic in Dayton, Ohio, and later was assigned to the Dayton office as safety engineer. In 1949 he was on special assignment to coordinate safety information and regulations and revise Ethyl's safety manual. He was transferred to the Southern Region after completion of this assignment.

Newman, a native of Portsmouth, Ohio, was graduated from the University of Notre Dame in 1925 with a bachelor of science degree. He is a member of the Institute of Radio Engineers.

Newman is a coon hunter, fisherman, and "ham" of no mean ability. He got his first amateur transmitter in 1917 and two years later received a first-class commercial operator's license. During the

John W. Nee

George E. Mapstone

Dr. Hans Schindler

Fred L. Plummer

William A. Newman

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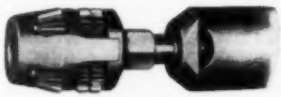

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DISTRICT OFFICES IN PRINCIPAL CITIES

Vincent E. Bowes

L. R. Lyon

H. B. Manley

R. A. Feagan, Jr.

David M. Boyd, Jr.

Ohio River flood of 1937, he set up his transmitter on a cliff overlooking the river and gave rescue workers directions that was responsible for saving human life and property.

Another Daugherty Plant Contribution

Dr. Hans Schindler, at the Daugherty refinery of L. Sonneborn Sons, Inc., author of "Disposal of Refinery Waste Water Containing Water Soluble Sulfonates," page 152, is a native of Austria, but spent his early youth in Hamburg, Germany, where his family was engaged in the refining business. He was educated at the Institute of Technology of Munich and Berlin and the University of Prague, Czechoslovakia, where he received his Ph.D. after completion of a thesis on a problem of organic chemistry in 1934. Following his doctorate work, he spent three years in the plant of Oelwerke Julius Schindler in Hamburg.

In 1938, he came to the United States and joined the research development department of The Pure Oil Company near Chicago. In 1945 he was a member of the Technical Oil Mission which investigated the German synthetic and conventional petroleum industry, and in 1946 joined L. Sonneborn Sons, Inc., Petrolia, Pa.

Besides his work, which has included both development and plant processing of petroleum products starting with crude oil and ending with white oil and various specialty products, Dr. Schindler likes to spend his indoor hobby hours on his stamp collections. However, he likes the outdoors and derives real pleasure from hiking and swimming in the summer and some skiing in the winter.

Tells Oakite Staff How to Clean 'Em

Vincent E. Bowes, who contributed "Chemical Circulation Methods in Cleaning and Descaling Petroleum Processing Equipment," beginning on page 121, is manager of the Petroleum Service Division of Oakite Products, Inc.

A New Yorker by birth, Bowes was educated in public and private schools in New York City. After leaving St. Ann's Academy, he saw active service in the U. S. Navy, serving two years overseas in World War I. He joined Consolidated Edison Company, Inc., in New York City and served in supervisory capacity in the manufactured gas plants for 15 years. In the electrical production division of this company he served for two years as an engineer in the electrical generating stations.

Bowes joined Oakite six years ago in the technical service department specializing in power projects. Later he was made manager of the petroleum service division. He coordinates and directs the activity of Oakite technical service representatives solving technical cleaning problems of the industry.

An ardent golfer, Bowes spends most of his leisure hours on the golf course. He is an active member of the API.

Trio Gives Details Of Elk Basin Plant

"ELK Basin Plant, a Real Conservation Project," the article written by L. R. Lyon, R. A. Feagan, Jr., and H. B. Manley of Stanolind Oil & Gas Company's engineering department, on page 116 in this issue, is a discussion of this somewhat unusual natural gas processing plant.

L. R. Lyon is a chemical engineer from the University of Kansas, having graduated in 1936. He is a Kappa Sigma and was elected to Tau Beta Pi and Sigma Tau, national honorary engineering fraternities. He joined Stanolind in 1946 and now is a job engineer in the construction section of the manufacturing department in Tulsa.

Before joining Stanolind, Lyon had been employed by Universal Oil Products Company, Associated Refineries, Phillips Petroleum Company, and Kanotex Refining Company.

He is married and his son, Edd, is two and a half years old. When the youngster permits his dad a little time off, Lyon indulges in his favorite hobbies of golf and fishing.

R. A. Feagan, Jr., is a Carolinian and a University of South Carolina (1938) graduate as a bachelor of science in chemical engineering. Before joining Stanolind he was with the U. S. Department of Agriculture at Olustee, Fla., and Commercial Solvents Corporation at Sterlington, La., and Terre Haute, Ind. He joined Stanolind in 1946 and is a process engineering supervisor in the construction department.

The Feagans have two children, daughter Anne, four years old, and son Andy, one month.

H. B. Manley joined Stanolind in January, 1947, and is a senior mechanical engineer. He was graduated from Kansas City (Mo.) Junior College, then studied civil engineering at the University of Missouri. Later, he studied chemical engineering at Rutgers and Columbia Universities. He worked with engineering construction firms in Kansas City, New York, Wichita and Foxboro, Mass., and also for several oil companies. A member of ASME, he is licensed as a professional engineer in both New York and Missouri. The Manley's son, David, is 10 years old and sometimes participates in three of his dad's principal diversions of golf, fishing and carpentry. Later, perhaps, he will join the fourth—bridge.

Finds That Work And Hobbies Mix

DAVID M. BOYD, JR., author of "Process Control by Graphic Panel" (page 129), is a man whose principal hobby runs parallel with his work. In fact, the hobby, which is electronics, diverted him somewhat from the course on which he originally embarked, and brought him into the instrument field.

Graduating from the University of Colorado in 1941, as a chemical engineer, Boyd joined the Barrett Company in Philadelphia as a member of the pilot plant group. As soon as it became known, however, that he had built a couple of television sets at home, he was transferred to the instrument department, and instruments have claimed his major attention ever since, while employed successively by Blaw-Knox Construction Company, Pittsburgh; the Eastern States Petroleum Company, Houston, and Monsanto Chemical Company. With the latter organization he was in charge of the instruments applications group at Oak Ridge, Tenn.

Boyd joined the Engineering Department of Universal Oil Products Company in March, 1948, as an instrument engineer concerned with new developments and applications of instruments. Recently he was appointed chairman of a committee of the Instrument Society of America on instrumentation for the process industries.

Just a year ago Boyd's "Fractionation Instrumentation and Control" appeared in these PETROLEUM REFINER pages.

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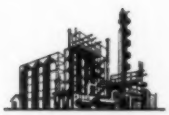

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McKee recognizes the importance of prompt, economical execution of contracts to transform capital investment into profitably operating plant in the shortest possible time.

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Hints That Will Save Plant Operators Both Time and Money

Maintenance and Operation—

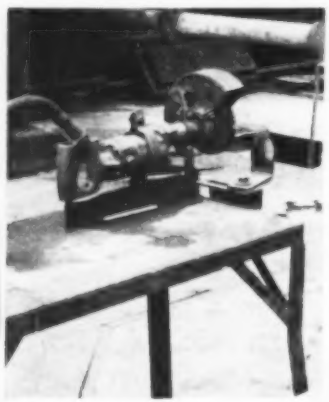
HOW TO DO IT

HOW TO—

Use Air Motor For Wire Brush

ONE of the numerous uses of air motors in the refinery is shown in the accompanying picture. The air motor is mounted in a pair of clamps welded to the small metal work bench and a wire brush mounted on the drive shaft. A safety shield is clamped to the shank of the air motor above the chuck. The tool rest is bolted to the edge of the table.

This equipment is easily transported about the plant for use in cleaning pipe and bolt threads and other small items. The air motor can be removed from the clamps for use on large equipment.



HOW TO—

Reel Fire Hose For Quick Use

THE time consumed in unreeling a poorly reeled fire hose may mean the difference between quickly controlling and extinguishing a fire and costly damages. One plant installed the hose reel shown in the picture. Water to supply the hose is piped from the main to a riser in a concrete base, then to the hose connection on the outer rim of the reel. The reel is supported by the riser, which is equipped with a ball bearing swivel joint. The hose can be unreeled quickly and easily by an operator.

HOW—

Detector Insures Leakproof Piping

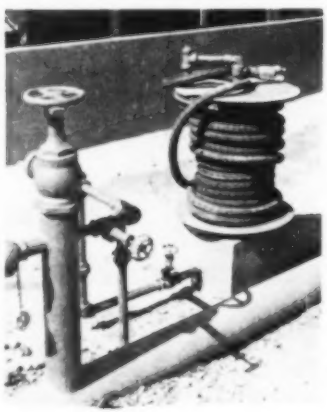
AN electronic leak detector has been developed, which is extremely sensitive to halogens —chlorine, fluorine, bromine, and iodine —and which can detect leaks of these gases from openings small enough to release only one ounce a century. This apparatus finds practical application in detecting leaks in process piping and pressure equipment.

There are excellent possibilities that the new instrument will find wide application in all branches of the petroleum industry — refining, petro-chemical, pipe line, natural gas processing plants, etc.

One recent test of the electronic detector was made by William E. Herrman, engineer in General Electric Company's special products division, to insure a leakproof condition in a radiant-heating system. Herrman introduced a gaseous halogen compound (freon) into the 1800 feet of one-half inch copper tubing of the system. Then, John S. Hickey, one of the men who participated in the development of the detector, passed the tip of the instrument's pistol-shaped pick-up through the air surrounding the tubing. If any trace of the halogen was present, the leak detector indicated the fact on the dial of its electronic unit.

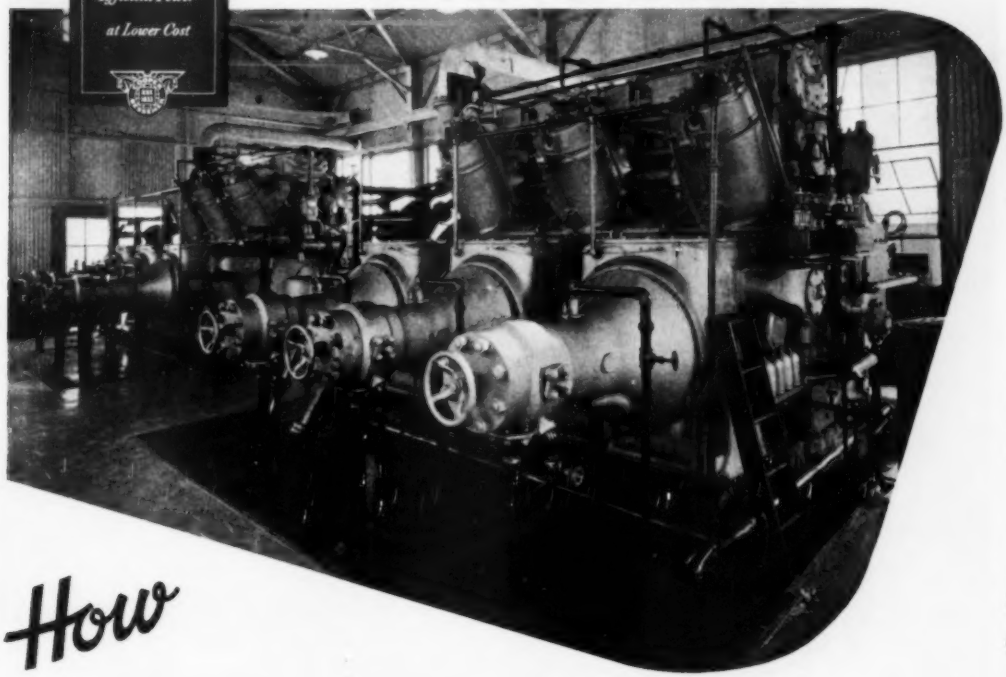
Herrman reported that about 100 joints in the tubing were checked in this manner in less than two hours. Three leaks, undetected by two different previous tests, were spotted immediately. If the leaks had not been detected and repaired before plastering was done, repair at a later date would have entailed considerable difficulty and expense, Herrman said.

This hose and fog nozzle can be unreeled evenly without kinking.



Another Example of Efficient Power at Lower Cost

These two 6-cylinder GMV's provide 1200 compressor horse-power at Western Natural Gas Company's 3-well, Goebel Field cycling plant. Currently compressing 15,000 Mcf of gas daily, from 1,500 to 3,500 psi, units have capacity for 30,000 Mcf to meet anticipated increases in volume of gas to be handled.



How GMV compactness and durability pays off

for Western Natural

The two Cooper-Bessemer GMV compressors you see here have outlived the cycling requirements in one field... and are now doing an efficient job in a new location. Installed eight years ago at Edinburg, Texas, they were recently transferred by Western Natural Gas Company to handle the compressor requirements at their new Goebel cycling plant in Live Oak County, Texas.

This "case history" is significant. First, it testifies to the long, efficient life of these modern Cooper-Bessemer V-angles — units that obviously are ready for many more years of trouble-free, low-cost operation. Secondly, it emphasizes the advantage of GMV compactness — compressors that are installed, housed, operated and maintained at exceptionally low cost.

Cooper-Bessemer V-angles, long-lived, unusually compact, are built in three types for all compressor needs from 200 to 2400 bhp. Let Cooper-Bessemer prove to you how these modern units can add to your profits.

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• Here's a products pipe line terminal where three Graver Expansion Roofs provide the capacity to conserve the vapors in a 27 tank system. *All* the capacity of *all* the equipment is employed, because no venting can occur until all Expansion Roofs reach their maximum height.

Graver Expansion Roofs effectively prevent all breathing or standing losses; and when vapor volumes are balanced during filling and emptying operations, they also eliminate filling losses. In addition, Graver Expansion Roofs offer the advantages of simplicity of design, ease and accuracy of gauging, low maintenance costs, and perfect roof drainage.

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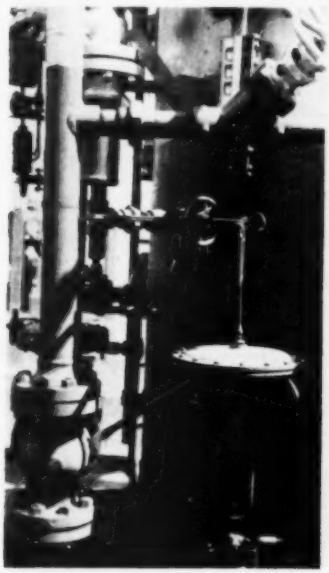
HOW TO—
Support Control Valve Tubing

DAMAGE to tubing connected to the diaphragm case of control valves can be prevented, and the line kept in good condition indefinitely by protecting it with a bracket. When the valve is set close to a pipe riser or a stanchion of a building, the line can follow the larger object to the point nearest the valve. The bracket is made of a iron strap, bent sharply at right angles. The end, at the top of the diaphragm has a hole drilled in a sharply turned lip to fit beneath the lock nut holding the copper tubing fitting to the casting. The opposite end, laid in a horizontal line is fastened by welding, or may be bolted to an ear, which in turn is welded to the vertical member; pipe line, or studding. The copper tubing is fastened on the outer side of the angle with clips.



HOW TO—
Flush Open Drains

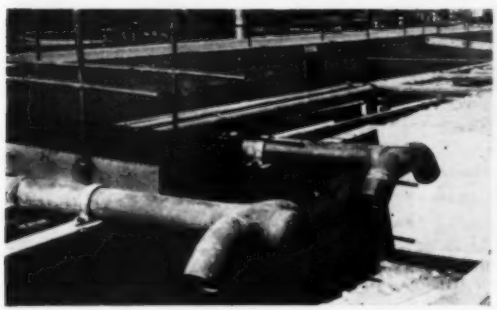
Open drains into the sewers of a plant can be flushed continuously to keep the grating clean, prevent escape of vapors, and eliminate odors present with a spray of water above the grating. The spray is shown in operation in the accompanying picture.

HOW—
Step Plates Aid Engine Inspection

STEP-plates can be attached to the side of the bed-plate of large horizontal gas-engine driven compressors to provide a convenient means for the engine room operator to inspect and service the sight feed lubricators, or check the condition of the main bearings without using a stepladder. The material used for the step-plates is heavy walk-way steel. The lower step is about 8 inches x 10 inches having approximately 3 inches of one side turned sharply down at an angle of 90 degrees. Two holes bored in the 3-inch section match holes bored in the bedplate of the engine and tapped for three-quarter inch capscrews to attach the step-plate. The second step also is made of a rectangular piece of material, which is fitted with two heavy legs secured to the engine by the bed-plate cover cap screws. The length of the legs permit plate to lie flat with the outer edge resting on the layshaft housing.

HOW TO—
Construct Decoking Discharge Headers

THE equipment shown in the pictures was developed for visual inspection and sampling of the effluent leaving the discharge lines on a heater decoking system. In this installation, the lines pass through conduit pipes beneath the refinery roadway. On the opposite side of the roadway from the heaters, a large concrete pit was constructed into which the discharge pipes empty during decoking. These lines terminate in tee headers consisting of pipe nipples and 45 degree bends, so that the fluid and coke flow downward without splashing. In operating the discharge lines with plain tees, the operators found that the impact of the coke tends to cut the walls of the tee. This problem has been overcome by using a cross instead of a tee with the downstream opening closed with a bull plug. Coke accumulates in the plug and acts as a cushion preventing damage to the piping.



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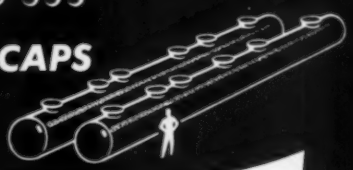

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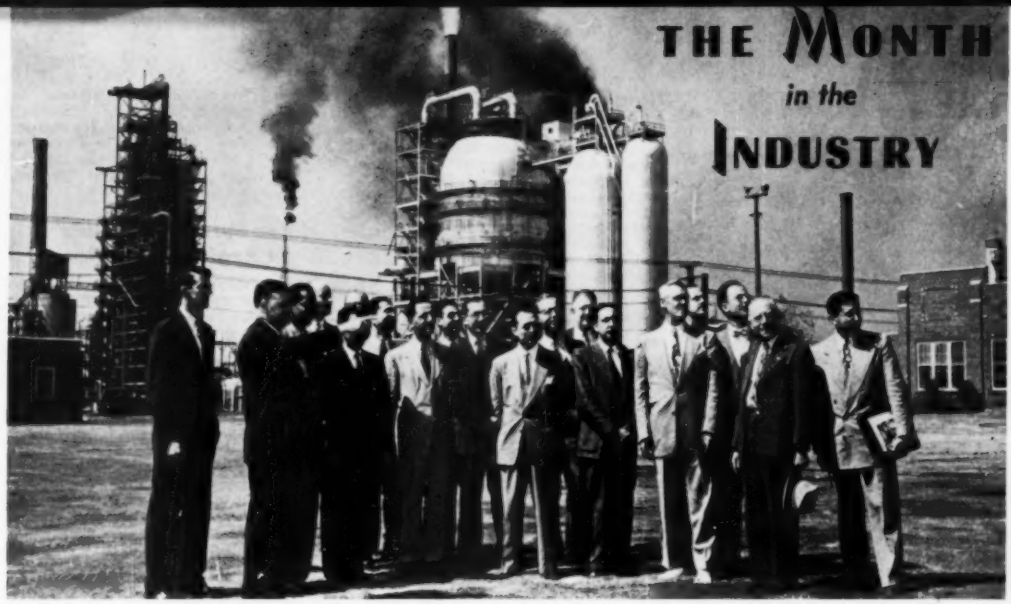

U.N. ENERGY OBSERVERS INSPECT ESSO INSTALLATIONS—Eighteen members of the Fuel and Energy Section of the United Nations Conference on the Conservation and Utilization of Resources early last month visited refining and research facilities of two Standard Oil Company (New Jersey) affiliates at Linden, N. J.

Above, pictured before the large catalytic cracking unit, newest addition in Esso Standard Oil Company's refinery expansion program, D. L. Ferguson (pointing), manager of the company's New Jersey works, points out various other installations to the group during its tour of the company's Bayway refinery. The group also visited the Esso research center of Standard Oil Development Company, the central research affiliate of the Jersey Standard organization.

NGAA Southern Regional Meeting Held in Tyler

Practical problems in the operation of gasoline plants will provide the theme for the Southern Regional meeting of the Natural Gasoline Association of America, in Tyler, Texas, Friday, October 14. The one-day meeting will be divided into two sessions, the first to be presided over by W. A. Bowser, The Atlantic Refining Company, and the afternoon session by H. W. Harts, Warren Petroleum Corporation, Tulsa.

Presentations of the morning session will include "Corrosion in Gasoline Plants" by John H. Naschke, Humble Oil & Refining Company, Houston; "Compressor Lubrication and Packing Problems" by E. H. Flaherty, Clark Bros. Company, Inc., Olean, N. Y.; "The Relation of Personnel to Plant Efficiency" by M. V. Cousins, United Gas Company, Shreveport, La., and "Operation and Maintenance of Cooling Towers" by J. B. Baird, Hudson Engineering Company, Houston.

In the afternoon session, NGAA President James E. Pew, Sun Oil Company, Philadelphia, will speak on "Free Men Forging Their Own Chains." Other papers include "Some Practical Considerations in Gasoline Plant Instrumentation" by C. F. Woods, Brown Instrument Division, Minneapolis-Honeywell Regulator Company, Dallas; "Explosions in Air Starting Systems" (a survey of causes and cures) by Paul Lindeman, Phillips Petroleum Company, Bartlesville, Okla.; "The Automotive Engineer Starts a Chain of Events" by B. R. Carney, Warren Petroleum Corporation, Tulsa.

The Natural Gasoline Supply Men's Association will be hosts for the annual fellowship hour, which will be followed by a buffet dinner and entertainment.

The one-day meeting is under the joint sponsorship of the NGAA and the East Texas Natural Gasoline Men's Club.

THE OIL MAN'S CALENDAR

OCT. 10–14	American Society for Testing Materials, West Coast Meeting, San Francisco, Fairmont Hotel.
12–14	Texas A&M Fourth Short Course on Instrumentation, College Station, Texas.
13–14	Texas Mid-Continent Oil and Gas Association, Annual Meeting, Houston, Rice Hotel.
17–20	American Gas Association, Annual Convention, Chicago.
17–21	American Society for Metals, National Metal Congress and Exposition, Public Auditorium, Cleveland.
25	National Petroleum Council, Quarterly Meeting, Washington, D.C.
31 to Nov. 4	National Safety Council Congress, Chicago, Morrison Hotel.
NOV. 1– 2	Society of Automotive Engineers, Diesel Engineers, St. Louis, Chase Hotel.
1– 5	Pacific Chemical Exposition, San Francisco, Civic Auditorium.
3– 4	Society of Automotive Engineers, Fuels and Lubricants, St. Louis, Chase Hotel.
7–10	American Petroleum Institute, 29th Annual Meeting, Chicago, Stevens Hotel.
7–10	American Institute of Chemical Engineers, Pittsburgh, Hotel William Penn.
27 to Dec. 2	American Society of Mechanical Engineers, Annual Meeting, New York, Hotel Statler.
28 to Dec. 3	Twenty-second Exposition of Chemical Industries, New York, Grand Palace.
DEC. 4– 7	American Institute of Chemical Engineers, Annual Meeting, Pittsburgh, William Penn Hotel.

OIIC Plans Observance Of Oil Progress Week

The Oil Industry Information Committee's observance of National Oil Progress Week will be held October 16-22 at the Stevens Hotel, Chicago. At a two-day meeting last month in Chicago, the OIIC discussed a script now being prepared for a 30-minute motion picture in color on the oil industry. The movie is scheduled for completion next year. The committee also reviewed a new 35-millimeter sound-color slide expected to be released shortly for retail service station dealers.

Phillips Petroleum Names Chemical Products Manager

Miller W. Conn has been appointed assistant manager of the chemical products department, Phillips Petroleum Company, Bartlesville, Okla. Dale Fischbeck succeeds him as manager of the company's processes licensing division. Conn, with Phillips since 1936, will be in charge of the Perco, special products and drilling specialties division.

Fischbeck joined Phillips in 1946, prior to which date he had more than 18 years experience in the petroleum industry, including positions of chief chemist, refining and pipe line operations superintendent and superintendent of an asphalt plant.

Adsorption Technique Aired in Symposium

Improvements in petroleum refining made possible by the relatively new adsorption technique were reported at a symposium of the nation's oil chemists during the American Chemical Society's 116th national meeting in Atlantic City last month. Petroleum chemists have found this principle of adsorption of great economic importance in separating small amounts of specific gases from mixtures. Recovery of these gases, formerly wasted, helps conserve the natural resources of the country and also pro-

THE MONTH . . .

vides an additional source of revenue for the petroleum industry.

Also discussed at the symposium was the recent research on the giant molecular structures of the type making up rubbers, fibers and plastics. Leading authorities presented thirty technical papers which dealt with the fundamental nature of adsorption, the research applications and the analytical and commercial applications.

The petroleum division conducted a symposium on "The Nomenclature of Hydrocarbons" in which the divisions of chemical education, chemical literature and organic chemistry explored methods of simplifying the problem of classifying the many thousands of hydrocarbons and other carbon-containing chemicals.

Hallanan Urges End To Oil Imports Fight

Imports should not be permitted "to drown out the domestic oil industry and thus destroy the first line of national defense," in the opinion of Walter S. Hallanan, chairman of the National Petroleum Council, who called upon the industry to keep faith with its policy that "imports should be used to supplement and not supplant domestic production."

"It is important to remember that there is no security in foreign oil reserves that might not be available in time of an emergency," he added. "We must have adequate reserves to meet any contingency that may arise and we must have them here at home. More than that, the national safety demands that we have a sound and healthy industry with an excess productive capacity at its finger tips."

Shell Oil Union Approves Plans to Merge Shell Oil

Shell Union Oil Corporation directors and stockholders have approved the plan to merge the assets and identity of its operating subsidiary, Shell Oil Company, Inc. into Shell Union, as of September 30, and to name the consolidated entity the Shell Oil Company.

Officers include: H. S. M. Burns, now president of the operating company, named president and director of the consolidated company; Alexander Fraser, currently Shell Union president, chairman of the executive committee; George Legh-Jones was named to continue as chairman of the board, and all presidents of the operating company were elected to similar positions in the consolidated company; Vice President P. E. Lakin was also elected a director and continuing senior representative of the Pacific coast.

California Names Best

Paul A. Best has been named to the newly created office of assistant to president E. W. Endter of California Oil Company, a wholly owned subsidiary of Standard Oil of California. Best is former associate director of distribution for the Armed Services Petroleum Board, now a committee of the Munitions Board in Washington, and was assistant director of marketing for PAW before entering the Navy.

Humble Names Coordinator For Hydrocarbon Sales

Joe Miller, formerly assistant gas superintendent for Humble Oil & Refining Company, has been appointed to a newly-created position as coordinator of the company's supply and sales of light hydrocarbons. The new job was set up "to coordinate supply, distribution, and sales of increasing quantities of propane, butane, and other light hydrocarbons being produced by the Baytown refinery and by natural gasoline and gas cycling plants over a wide area." Sales of these products were previously handled independently by three different departments.

Miller

Miller will be responsible for contract sales of propane and butane to refiners, chemical plants, and major wholesale distributors.

Interesting Papers at CNGA Annual Meeting

An "Information Please" session and several technical papers featured the annual meeting of the California Natural Gasoline Association meeting held October 7 in Los Angeles. Fred L. Hartley, Union Oil Company, served as general chairman.

First presentation was that of Melroy Welch, superintendent of the gas department of Barnsdall Oil Company, "Barnsdall Newhall-Potrero Gas and Gasoline Plant." He discussed features of the new plant including elimination of plant vapors by complete condensation of still overhead and, process steam generation without fire by use of waste heat from the lean oil.

"Continuous Coking—Catalytic Cracking" by A. H. Schutte, process development engineer of The Lummus Company, New York, was a discussion of the new continuous coking process and the over-all application of the process in an existing refiner's operations.

G. R. MacPherson, senior research engineer, and F. Sipos, research engineer in refinery technology, California Research Corporation, discussed "The Effects of Natural Gasoline on Motor Gasoline Qualities." They pointed out that the performance of motor gasoline is dependent upon many factors including the properties of the motor gasoline controlled by the refiner. Also, that while natural gasoline is useful in balancing refinery production to meet product demand and in meeting gasoline specifications, its use may be limited by performance requirements of the gasoline in which it is used.

The "Information Please" session was held after an address by J. B. Taylor, president of CNGA. Moderator of the information session was T. L. Taggart, manager of the natural gasoline department of Standard Oil Company of California, and a past president of the association. The panel of experts to which the questions were directed included James Pew, Sun Oil Company, and president of the Natural Gasoline Association of America; Howard Mongromery, Warren Petroleum Company; Coles Bason, Ingersoll-Rand Company; Dr. Frank Lockhart, University of Southern California; George Ehrhart, Ehrhart and Arthur; Ira C. Bechtold, The Fluor Corporation; Marion Fort, Pacific Lighting Corporation; and Charles Day, Richfield Oil Corporation.

Mines Bureau Appoints Eight Regional Directors

Department of the Interior Bureau of Mines has appointed regional directors as follows: Paul Zinner, North Central region; Stephen M. Shelton, Northwest; Sinclair H. Lorain, Region I, Alaska; Harold C. Miller, Southwestern region; Harold P. Greenwald, Northeastern region; Joseph H. Hedges, chief of the new minerals division with headquarters in Washington, D. C.; Dr. Clifford W. Seibel, South Central region; and John H. East, Jr., Rocky Mountains.

Houdry Plant Manager Named; Chaberek Added

Raymond B. Cross has been appointed manager of Houdry Process Corporation's Paulsboro, N. J. catalyst plant. Cross who has been with the company for 13 years, was chief chemist when the plant went into operation in 1940. He will succeed A. R. Worrall, former manager of the plant who is leaving the company to accept a position with Davison Chemical Corporation in Baltimore.

Houdry also has announced the addition of Dr. Stanley Chaberek, Jr. to the research staff of the company's laboratories in Linwood, Pa. Dr. Chaberek comes direct to Houdry from Clark University in Worcester, Mass., where he was awarded his doctor's degree in chemistry in August of this year.

Lincoln Foundation Contest Offers Engineering Grants

The third annual competition of the engineering undergraduate award and scholarship program, has been announced by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio, which offers annually $6750 in awards and scholarship funds to engineering undergraduate students and to schools for the best papers prepared by undergraduates on arc welding design, research, fabrication or maintenance.

Rules may be obtained from The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Cooper Alloy Contest

Awards totalling more than $5000 have been offered by The Cooper Alloy Foundry Company, Hillside, N. J. in a proposed essay contest for the best technical papers dealing with "Applications for Cast Stainless Steel in the Chemical Industry." These contests are intended to cover the major fields of application including chemical, food, textile, paper and pulp, aircraft, petroleum, and marine.

Information concerning the contest may be obtained by writing The Cooper Alloy Foundry Company, Hillside, N. J., Attention: Contest Editor.

Shell Chemist to Houston

Julius D. Heldman has been transferred to the research laboratory at the Houston refinery of Shell Oil Company

H_2S ...valuable nuisance!

Hydrogen sulphide in hydrocarbon mixtures is a nuisance, plain and simple. It corrodes equipment and piping. It poisons catalysts. It enters into undesirable side reactions. Its removal is usually expedient.

It can be removed and recovered, economically, by Girbotol scrubbing. Disposal of the recovered hydrogen sulphide, however, presents a serious problem. It is a highly toxic gas with a thoroughly bad odor. And, even when burned in a flare, it contributes to atmospheric pollution.

What can be done? Plenty. With a Girdler plant you can turn that hydrogen sulphide into elemental sulphur, a product much in demand nowadays. The nuisance thus becomes valuable!

A lot of people are finding it good business to get set with Girdler for sulphur production. On a by-product level, capacities as low as ten tons per day have proved feasible. Or, when the quantity of hydrogen sulphide is high, sulphur production can be a worthwhile, large-scale business.

Girdler is now building sulphur plants and offers expert process design, engineering, and construction services for sulphur plants of virtually any capacity.

Turn *your* hydrogen sulphide liability into an elemental sulphur asset! Arrange for a meeting with Girdler engineers.

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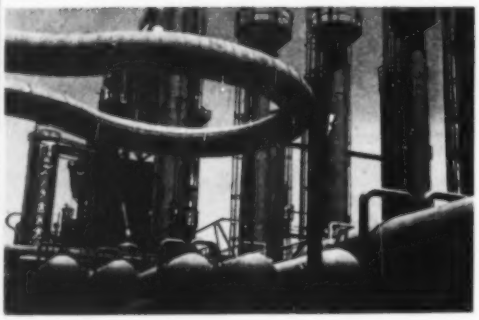
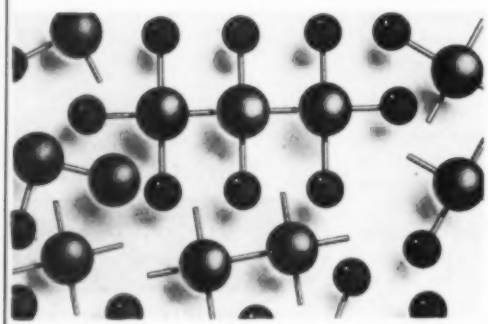


to conceive, plan and build plants . . .



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Engineering and Construction Division

JONES & LAUGHLIN SUPPLY COMPANY

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where he will be general program adviser to the research director. Dr. Heldman, who joined the company in 1945 as technologist in the manufacturing department in San Francisco, was formerly chief research chemist at the company's Wilmington, Calif., refinery.

Fluor Becomes Mathieson's Sulfur Recovery Agent

The Fluor Corporation, Ltd., Los Angeles, has concluded an agreement with Mathieson Chemical Corporation, New York whereby The Fluor Corporation becomes Mathieson Chemical Corporation's sole licensing agent for the engineering and construction of sulfur recovery plants in the United States and Canada. The plants engineered by Fluor will embody Mathieson's "Sasco" process for the recovery of sulfur from hydrogen sulfide gas, acid sludge, and similar refinery waste products.

Mathieson thus will grant licenses for the use of its sulfur recovery processes only to those firms nominated by Fluor and will supply the necessary technical information, as well as the services of technicians, who will assist in the design and operation of plants licensed under the agreement. Fluor will be employed to construct sulfur recovery plants which Mathieson will require for its own use and will be recommended for the construction of similar plants to be owned by others, it was explained.

Magnolia Sets Up Fifth Fellowship in Southwest

Magnolia Petroleum Company has established a graduate fellowship at Texas A. & M. College, the fifth to be set up in the Southwest, others being in physical chemistry at the University of Texas, in physics at Rice Institute, geology at Louisiana State University and in chemical engineering at the University of Oklahoma. Charles D. Holland, the first recipient of the A. & M. fellowship, has been a graduate assistant in the chemical engineering department of A. & M. nearly two years. He was graduated from North Carolina State College.

Fifty Years of Service

James Baadsgard, foreman in the can factory at the Whiting refinery of Standard Oil Company (Indiana), was awarded a gold watch from the board of directors at the general office of the company in Chicago, in celebration of his 50 years of service with the factory. He will retire on the company annuity in 1951 when he is 65 years old.

→

SAFETY AWARD—

For operating without a lost-time accident from November 25, 1938, to January 1, 1947, for a total of 750,000 man-hours, the Lovell Refinery of The Ohio Oil Company has received the United States Bureau of Mines' Joseph A. Holmes Safety Association Certificate.

In the photo, Ohio Oil President J. C. Donnell II, right, presents the certificate to Lovell Refinery Superintendent Bert B. Miller, while John C. Askam, center, personnel manager, safety; Vice President Charles Z. Hardwick, extreme left, manager of refining and marketing, and Ray E. Luton, extreme right, manager of refining division, look on.

Bureau Report Estimates Costs of Coal-to-Gasoline

"Estimated Plant and Operating Costs for Producing Gasoline by Coal Hydrogenation" is a report prepared by staff members of the Bureau of Mines coal-to-oil demonstration plant at Louisiana, Mo., to aid in estimating the cost of producing synthetic liquid fuels commercially. The bureau calculates that "unlimited quantities of premium motor gasoline" can be produced from coal and marketed at prices 'only' three to four cents per gallon above current service station levels. The study was based upon figures for a projected 30,000 barrels per day plant using basic cold hydrogenation methods with addition of certain "process improvements." The estimates make no allowances for the return on capital investment in the plant costs which range from $243 to $258 million.

In explaining its calculation, the bureau said that the projected plant would be a "modernized" version of the coal hydrogenation unit "incoroparting some features that still require commercial development but have shown enough promise, experimentally, to justify their use." The most significant feature, the study explained, is the gasification of coal under 25 atmospheres of pressure.

Final merit of these innovations it was said, will be tested at the bureau's experimental coal hydrogenation plant at Louisiana, Mo. Also included in the report are costs per gallon of producing gasoline from five different types of coal; manufacturing costs; cost figures for what the bureau describes as "conventional design" hydrogenation plant—one without contemplated innovations such as pressure gasification.

For a copy write Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh. 13.

THE MONTH . . .

Western Refiners Discuss Refinery Waste Disposal

L. C. Burroughs of the Shell Oil Company, New York, and W. B. Hart of Atlantic Refining Company, Philadelphia, authorities on refinery waste disposal will be featured at a regional technical meeting to be sponsored by the Western Petroleum Refiners Association in Palmer House, Chicago, October 21. Waste disposal problems in light of new anti-polution laws which have been adopted in several states will be the topic. John S. Pfarr of Leonard Refineries, Inc., will be chairman.

Other speakers will discuss state and federal anti-pollution laws and action; measures recommended by the API to assist individual companies in solving their waste disposal problems; methods of investigating the extent of stream pollution as a preliminary step to adopting corrective measures; and equipment and procedures for disposing of objectionable wastes.

Rothschild Leases Refinery

Rothschild Oil Company has leased Olympic Refining Company's 6500-barrel-per-day refinery in Long Beach, Calif. This makes the third refinery acquired by Rothschild in that area, raising its thruput capacity to about 20,000 barrels per day.

Joins Enjay Staff

Gregory M. Hebert has joined the technical staff, Paramins division, of Enjay Company, Inc. He was formerly with Standard Oil Development Company, central technical organization of Standard Oil Company (New Jersey)

affiliates, engaged in research and field testing of lubricants and fuels.

A graduate in civil engineering of the University of Illinois, Hebert served as lieutenant-commander with the United States Navy during the war. Prior to his military service, he was with The Carter Oil Company from 1938 to 1942.

Refinery Fire Marshals Will Inspect Plants for Hazards

To help reduce fires and injuries in refineries is the work of the Refinery Fire Marshals, an organization sponsored and guided by the National Petroleum Association. The Kentucky-West Virginia group includes representatives from the Latonia refinery at Latonia, Ky.; Ashland refinery at Leach, Ky.; Elk refinery, Falling Rock, W. Va.; Pure Oil refinery at Cabin Creek, W. Va.; and Quaker State refinery at St. Marys, W. Va.

Refineries in these areas are inspected every two or three months for fire and accident hazards by members of the group who are fire and accident prevention experts in their respective plants. If any possibility of a hazard is evident, it is reported to the management for elimination.

Officers of this organization are F. N. Nicholson, Elk refinery, president; Charles Bach, Latonia refinery, vice president; and Frank Sluze, Ashland refinery, secretary.

Fire and Accident Elects

Fire and Accident Prevention Department of The National Petroleum Association, at its annual meeting at The Pure Oil Company Heath refinery, elected officers as follows: H. C. Salisbury, Kendall Refining Company, Bradford, Pa., president; Russell Potts, Indiana Farm Bureau Association, Mt. Vernon, Ind., first vice president; F. A. Nicholson, Elk Refining Company, Falling Rock, W. Va., second vice president; W. E. Dunning, Freedom-Valvoline, Freedom, Pa., treasurer; and Theron Arras, National Refining Company, Findlay, Ohio, secretary. The retiring president is L. E. McArthur of Ashland Oil & Refining Company, Canton, Ohio.

The meeting featured an address by Tom A. Burke, director of local safety programs, National Safety Council, Chicago, and an address on refinery metal inspection by Harry Bennet, field engineer, Universal Oil Products Corporation, Chicago.

Compact Sees Significance In Oil Stocks Reduction

Stock changes for the total of all oils should be considered in the light of the seasonal pattern of demand which normally calls for additions to stocks in summer and withdrawals in winter in order to reduce wide fluctuations in industry operations, the Economics Advisory Committee said in its September report to the Interstate Oil Compact Commission. "Therefore," the committee asserted, "it is particularly significant that stocks of all oils were reduced in July and August." According to the report for the first eight months of 1949, crude oil stocks increased by about nine million barrels in that period, while stocks of product increased about 16 million barrels. At the end of August, stocks were higher than a year ago by 33 million barrels of crude oil and 47 million barrels of products.

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

(All figures in thousands of barrels—add 000)

Trends in Week Ended	Crude Oil			Gasoline		Gasoil and Distillate		Residual Fuel	
	Production Daily	Runs to Still's Daily	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End
1948:									
January 31	5,318	5,474	228,083	15,986	102,973	7,080	37,733	9,141	35,510
February 28	5,387	5,463	226,950	15,706	111,040	7,963	30,680	8,624	34,742
March 27	5,377	5,324	229,409	15,793	112,991	7,682	27,483	8,854	33,483
April 24	5,415	5,517	228,488	16,515	111,128	8,831	30,808	8,877	34,437
May 29	5,452	5,715	228,979	17,827	107,185	7,054	34,862	9,508	39,669
June 26	5,494	5,674	229,632	17,938	104,178	7,300	41,137	8,858	42,558
July 31	5,455	5,718	230,720	17,646	99,116	6,823	52,429	9,080	48,618
August 28	5,529	5,682	229,873	17,722	98,504	7,491	61,814	8,818	53,544
September 25	5,343	5,293	234,183	16,705	90,410	6,656	71,428	8,390	57,745
October 30	5,604	5,626	239,702	17,369	91,925	7,679	77,118	8,853	60,845
November 27	5,617	5,721	244,246	17,317	89,802	7,476	80,375	9,477	63,960
December 25	5,641	5,784	250,555	18,178	100,286	7,776	74,576	9,121	63,374
1949:									
January 29	5,493	5,490	255,459	17,531	114,677	7,547	63,142	8,178	63,333
February 26	5,401	5,412	261,965	17,621	124,382	7,430	54,008	8,225	59,348
March 26	5,186	5,353	266,506	17,417	128,087	6,167	48,721	8,305	58,792
April 30	4,980	5,273	271,255	17,969	124,787	6,681	49,959	8,185	60,174
May 28	4,961	5,297	275,190	18,324	120,661	5,943	55,971	8,144	63,758
June 25	4,944	5,322	274,114	18,462	113,715	5,148	63,049	7,856	66,146
July 30	4,731	5,187	271,999	18,058	109,964	6,293	70,767	7,205	67,166
August 27	4,709	5,215	264,458	18,180	108,280	6,491	74,718	7,597	68,394
September 24	4,933	5,377	259,189	18,152	105,262	6,553	81,414	7,419	68,143

Stanolind Researchers

Stanolind Oil and Gas Company has advanced Charles E. Buffum and Ralph E. Hartline to research group supervisors and Harold M. Lang to senior research engineer. Buffum, who joined the company in 1934, was formerly construction and technical service section supervisor. Hartline was a senior research engineer before his recent promotion, and Lang was formerly instrument shop supervisor at the laboratory.

Nichols Succeeds D. J. Hanna In Caltex, Bahrein Offices

Howard B. Nichols has been elected a director, vice president and a member of the executive committee of California Texas Oil Company, Limited, and a director of The Bahrein Petroleum Company, Limited, of which he is now a vice president and a member of the executive committee. In these new offices, Nichols succeeds the late D. J. Hanna, who died in July.

Nichols

Nichols has been with the Caltex-Bahrein group of companies since January, 1938, and had previously assisted in the design of the Bahrein refinery, Persian Gulf, which began construction in 1936. He has been active in petroleum refining since 1923, when he graduated from Stanford University with a degree in engineering. Nichols spent a total of 14 years at Standard Oil Company of California refineries, specializing in cracking and refining processes.

Air Force Intelligence Seeks Refining Personnel

The Strategic Vulnerability Branch of the Directorate of Intelligence, United States Air Force, is seeking to employ people especially with experience in refining design and construction or in operations, petroleum engineering and related fields. The positions vacant at the present range from $3727 to $7432.20, depending on pertinent experience and education. Employment will be in Washington, D. C. and classified under Civil Service. Write Major N. R. Cathcart, Room 4B 930, The Pentagon, Washington 25, D. C.

Standard (Indiana) Names Benton, McCloud Directors

Dwight F. Benton, former president of Root Petroleum Company, Shreveport, La., and Bentley G. McCloud, president and director of the First National Bank of Chicago have been named directors of Standard Oil Company (Indiana). Benton succeeds R. F. Baity as general manager of sales, whereas McCloud will succeed Bruce K. Brown who recently resigned as vice president and a director to become president of Pan-Am Southern Corporation, a Standard Oil (Indiana) subsidiary with headquarters in New Orleans.

Molecular Weight Alcohol Developed by Monsanto

Monsanto Chemical Company's central research department has developed "AE-1," a new molecular weight alcohol which has potentialities as a chemical intermediate for use in resins, plastics, protective coatings, adhesives, and oil additives. The announcement was made to a group of nine university professors in Dayton, Ohio, attending the company's Two-Way Street Conference which was originated by the company for the interchange of knowledge and information relative to preparing science and technology students for industry.

Two Appointed for Sun Oil

Sun Oil Company has announced appointments as follow: G. Clifford Johnson, former assistant superintendent in

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THE MONTH...

charge of maintenance and construction, named superintendent in charge of mechanical departments at the company's Marcus Hook, Pa., refinery, and Edward J. Field, Jr., appointed administrative engineer of the company's manufacturing engineering department in Philadelphia.

Foote Mineral Purchases New Building for Research

Foote Mineral Company, Philadelphia, has purchased the Easttown School Building, Berwyn, Pa., a three-story brick structure, which will be used for scientific research and development purposes covering work carried out by the company's research and development department.

Within the next three months it is planned to move the laboratory of research and development activities from the present location at 4041 Ridge Avenue to the new building at Berwyn. A separate building at the Exton plant has been provided for pilot plant operations carried out under supervision of the research and development department.

Dr. S. C. Ogburn, Jr., a director of the company, as manager, research and development, will be in charge.

Holman Cites Conditions For Overseas Investments

Eugene Holman, president of Standard Oil Company (New Jersey) last month told a joint congressional economic committee that he believes the two most important obstacles to increased investments abroad by his company are restrictions on currency convertibility and the "nationalistic tendency" of some governments.

Assurances that the petroleum industry would not be nationalized in Britain were obtained from the present labor government, he said, before his company and its affiliate, Anglo-American Oil Company went ahead with the program to increase capacity of its refinery at Fawley, Eng. from 18,000 to 110,000 barrels per day and to up total investment to $150 million.

Since the end of the war, Holman said, his company and its affiliates have made total property, plant and equipment investments of $1.5 billion of which two-thirds have been in the United States.

"From 1945 through 1949, the United States oil industry as a whole will have made capital investments aggregating over $11 billion, equal to about two-thirds of the industry's entire gross investment in this country at the end of 1944," he said. "During 1948 alone, American oil companies supplied four-fifths of $1.5 billion of private investments abroad by all American private interests."

Both at home and abroad, Holman told the committee there is a need for continuing outlay of funds for investment purposes.

"The demand for petroleum will continue on an upward trend far into the future, but America never has to worry about liquid fuel for running its automobiles or anything else, period," he declared.

Interesting Refining Talks and General Sessions Scheduled by API

"Ninety years of progress" is the theme of the American Petroleum Institute's 29th annual meeting, November 7-10, Chicago, where is scheduled "the most interesting sessions ever held by the oil men's national trade association." Last year's registration of 5246 is expected to be exceeded at the forthcoming sessions.

Two general sessions will be held this year instead of the customary three, the third being supplanted by a group session Thursday morning by the Division of Refining, the topic to be "Fuels of the Future." Papers to be read at this meeting include "Fuels—Their Present and Future Utilization," William M. Holaday, Socony-Vacuum Oil Company, Inc., New York and "Liquid-Fuel Supplies and National Security," Dr. Walter G. Whitman, Massachusetts Institute of Technology. These papers will touch upon synthetics, imports and other key issues and will be followed by a general discussion.

The Wednesday afternoon general session will open with the president's address and will feature other addresses by Robert E. Wilson, board chairman of Standard Oil Company (Indiana), Chicago and J. Howard Pew, a director and retired president of Sun Oil Company, Philadelphia.

Presentation of the API Gold Medal for Distinguished Achievement also will be made Wednesday afternoon. Previous winners: 1946, Henry Ford; 1947, Dr. William M. Burton, former president of Indiana Standard; and 1948, Dr. Charles F. Kettering, scientist.

The Wednesday evening program includes talks by U. S. Senator Robert S. Kerr of Oklahoma ("America Unlimited"); Admiral Louis E. Denfeld, chief of naval operations ("What of Tomorrow?"); and Edmund P. Learned, professor of business administration, Harvard Graduate School of Business Administration ("Integration in American Industry.")

The Stevens Hotel will be the site of all meetings except those of the Division of Transportation which will be held at the Palmer House.

Committee sessions at Chicago (chairmen shown, when name available) include:

Saturday, November 5—Subcommittee on instruments, M. H. White. On Tank Accessories and Cleanouts, E. E. Kerns. Manufacturers Subcommittee on Safety and Relief Valves. Subcommittee of Refinery Inspection Supervisors, H. F. West.

Monday, November 7—Committee on Fire-Protection Regulations, W. N. Young. Gas and Electric Cutting and Welding, J. C. Bernd. Accident and Fire Press Relations, J. S. Boylan. Oxygenated Compounds, W. H. Jones. Subcommittee on Corrosion, M. S. Northrup. Lubrication Committee, Dayton P. Clark. Electrical Equipment, L. M. Goldsmith. Emission Spectroscopy, R. O. Clark. Tank Cleaning, E. O. Jones. Underground Gasoline Storage Tanks, J. H. Myers. Railroad Equipment, James E. Moss. Manufacturers Subcommittee on Refinery Valves, W. P. Klimont. Advisory Committee, Division of Refining, John W. Newton. Safety and Fire Protection, F. G. Wilson. Fundamental Research on Composition and Properties of Petroleum, H. G. Vesper.

Tuesday, November 8—Analytical Research, J. B. Rather, Jr. Fire Protection, J. E. Hill. Valves, Homer Reed. Refinery Equipment, Bonner H. Barnes. Disposal of Refinery Wastes, L. C. Burroughs. Accident Prevention, F. R. McLean.

Wednesday, November 9—Division of Refining general committee, Chester F. Smith. Electrical Equipment, L. M. Goldsmith. Nominating committee, Division of Refining, H. F. Glair. Program committee, Division of Refining, K. G. Mackenzie.

Undated committee meetings include:

Joint ASME-API Volumeter research, L. S. Wrightsman. Automotive Research, D. P. Barnard. Unfired Vessels, Walter Samans. Liquefied Petroleum Gas, E. H. Barlow.

The Texas Company Renews Cornell Engineering Grant

The Texas Company has renewed its graduate fellowship in chemical engineering at Cornell University. The School of Chemical and Metallurgical Engineering and the Department of Engineering Physics at Cornell University are cooperating with The Texas Company in studying the fundamental properties of metal films deposited on glass and quartz surfaces by evaporation to evaluate their usefulness in other research work on heat transfer. Research sponsored by this fellowship has yielded engineering data for better and more efficient design of heat transfer equipment.

Heat transfer rates for a large number of single vapors have been obtained and work is continuing on the measurement of rates for condensation of mixed vapors of known composition, such as those encountered in refinery processing and for which little accurate data are available.

Interprovincial Predicts Oil Refining Increase

Capacity of oil refineries in Canada's prairie provinces will be increased by more than 33½ percent to a total of approximately 90,000 barrels per day by 1951, according to a forecast made today by Interprovincial Pipe Line Company, an affiliate of Imperial Oil, Ltd. The company estimates the refining capacity in Saskatchewan and Manitoba, now about 32,400 barrels per day, will be raised to 47,400 barrels per day and that Alberta refineries will have a capacity of 41,550 barrels per day as compared with 34,550 barrels per day at present.

Bureau of Mines Praises Mining Oil Shale Methods

The Bureau of Mines believes that development of low-cost methods of mining oil shale at Rifle, Colo., has "removed one of the major deterrents to utilization of this country's mammoth reserves" in production of synthetic liquid fuels. In a recent test run, Bureau Director James Boyd said 29,835 tons of shale were mined at the "direct cost of only 32.9 cents per ton." He termed this "conclusive proof that the mining-cost problem has been solved."

Wins "Oscar of Industry"

Standard Oil Company (New Jersey) will be awarded a bronze "Oscar of Industry" for having the best annual report of the petroleum industry for the second consecutive year in the final ratings of an independent board of judges for the Financial World annual survey. The trophy will be presented at the annual awards banquet in New York,

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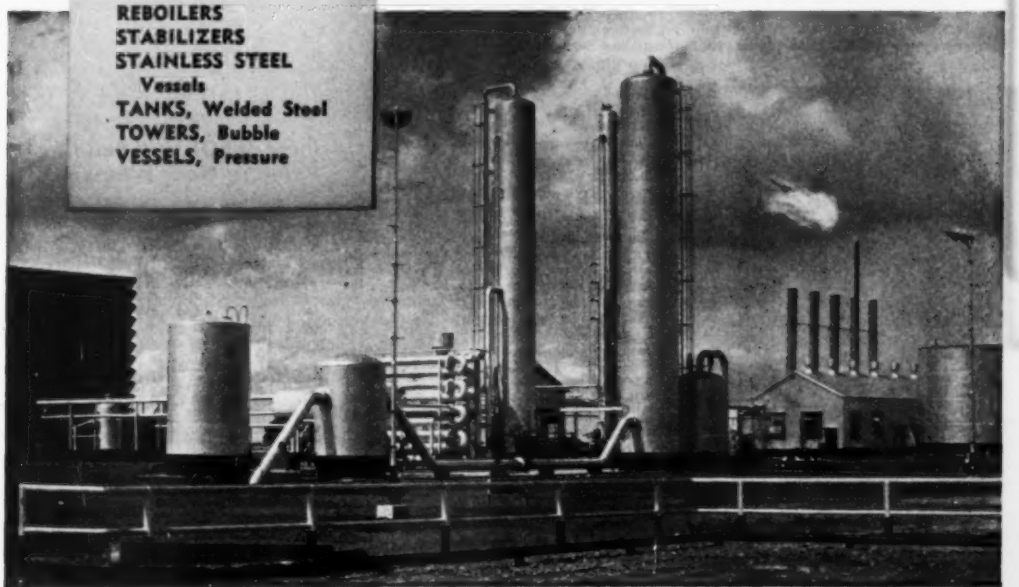

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THE MONTH . . .

October 31. In the "petroleum industry" category, Gulf Oil Corporation, Pittsburgh, won second place and Standard Oil Company (Indiana), won third place. More than 4500 corporation annual reports were submitted in this ninth national survey.

ECA to Help Finance Five Foreign Projects

The Economic Cooperation Administration has agreed to participate in the financing of five projects for expansion, modernization or rehabilitation of refineries and lube oil plants in Britain and France, involving a total cost of $150.4 million.

Shell Refining & Marketing Company, Ltd.'s Shell Haven, England refineries present capacity is to be expanded from about 8000 to approximately 66,000 barrels per day. Total cost is $58.4 million of which ECA's share is $10.04 million, including $2.23 million for engineering fees, etc. The plant will process Middle East crude with the products expected to be marketed entirely in the United Kingdom. The Llandarcy, Wales, refinery of National Oil Refineries, Ltd., a subsidiary of Anglo-Iranian Oil Company, is to increase its capacity from 350,000 to 700,000 barrels per year. Total cost will be $48 million of which ECA's share is $7.25 million.

The Berre refinery of Compagnie de Raffinage Shell Berre is to increase its capacity from 20,000 to 46,000 barrels per day and lube production from 140,000 to 245,000 barrels per year. Total cost is $31.6 million of which $1.85 million represents ECA's share. The crude is to come from Middle East and the entire output marketed in France and her overseas territories.

Socony-Vacuum Francaise's Notre Dame de Gravenchon refinery is to be rehabilitated and modernized for lube production up to 350,000 barrels annually. The plant was virtually destroyed by bombs in the war. Total cost is $6 million including $850,000 from ECA of which $500,000 will be used to buy equipment in the U. S.

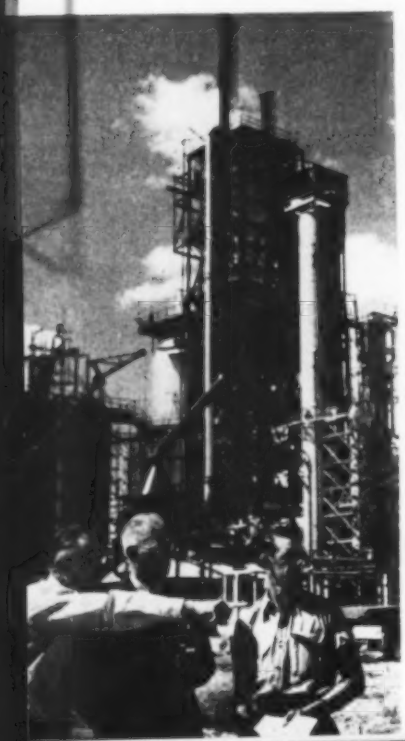
The Port-Jerome refinery of Standard Francaise des Petroles (Jersey Standard affiliate) is to expand its lube oil facilities up to 973,000 barrels per year. Total cost is $6.4 million of which ECA's share of $1.4 million will be expended for equipment in the U. S.

ECA believes that world crude petroleum outside North America and Eastern Europe will reach a level of 1,810,040,000 barrels per year in 1953. The report shows that, if all expansion plans are carried out, total refinery throughput outside North America and Eastern Europe would increase from 121.1 million tons (2,424,000 barrels per day) in 1948 to 211.5 million tons (4,424,000 barrels per day) in 1953, with the capacity in the participating countries alone rising from 19.2 million tons (384,000 barrels per day) to 64 million tons (1,280,000 barrels per day).

Gulf Builds $50 Million Refinery in Venezuela

Venezuelan Gulf Refining Company, in which Gulf Oil Corporation has two-thirds interest and The Texas Company, one-third interest, is constructing a $50 million polyform process plant at Puerto La Cruz, Venezuela, for the cracking of heavy gas oil with high gas dilution to produce higher yields of higher octane gasoline. The new refinery, with a daily capacity of 30,000 barrels, is scheduled to begin operations in the summer of 1950. It was designed on the basis of results obtained from polyform pilot plants at Gulf Oil Corporation's research laboratories at Harmarville, Pa.

The Lummus Company is constructing the refinery, and Chicago Bridge and Iron Works is erecting the tanks.



← REFINERY DEDICATED

Governor John W. Bonner of Montana, delivered the principal address at Continental Oil Company's open house, October 8, marking the opening of the company's new $9.5 million refinery in Billings, Mont.

The new refinery, located in the southeast section of Billings, near Yellowstone River, is Continental Oil Company's largest and northernmost plant in the Rocky Mountain states. The plant is now ready for preliminary tests.

Of most modern design, the plant contains a crude fractionation unit, propane deasphalting, catalytic cracking, catalytic desulfurization, catalytic polymerization and LPG facilities. Copper sweetening will be used for straight-run gasoline and doctor sweetening for the heating oils. All units are designed for balanced operations with no intermediate tankage. Interconnecting instrumentation co-ordinates the operations as the streams pass the various units.

The crude unit is designed to process 7555 barrels of crude oil daily. The catalytic cracking unit, shown in the accompanying photo is of the fluid type and designed to process 3770 barrels daily. Also shown in the photo are: Continental's western region manufacturing superintendent, J. E. Fenex, second from right, and Superintendent J. A. Ramsey, of the Billings refinery, on the left. (Also see photo, page 87.)

Pan-Am Southern Plans New Units at El Dorado

New facilities, including a 9300-barrel-per-day delayed coking unit, are to be constructed at Pan-Am Southern Corporation's 25,000-barrel refinery at El Dorado, Ark. New units in the extensive plant expansion program are expected to be in operation by September 1, 1950. Additions will include a new steam generating boiler, a water cooling tower, and coke handling and loading facilities.

R. T. Colquette, refinery general manager, said the new coking facilities and associated auxiliaries will provide much-needed flexibility "to meet increased requirements of gasoline and distillate fuels and to reduce yields of residual fuels."

The coking unit, on which The Lummus Company will be the engineering contractor, will include two vertical coke drums 17½ feet in diameter and 80 feet high, believed to be the largest of their kind ever installed in connection with this type of equipment. Hydraulic decoking will be employed and the two drums, operating on a 48-hour cycle, will produce approximately 420 tons daily of coke. The coke production will represent approximately 27 percent of the 12 gravity reduced crude charges. The unit will produce 1900 barrels per day of gasoline and 5200 barrels per day of gas oil suitable for conversion to high-octane gasoline by catalytic cracking.

Standard's New Company Plans Belgium Refinery

Standard Oil Company (New Jersey) has formed a new company, Esso Standard Refinery, which will build a new 25,000-barrel-per-day refinery at Antwerp, Belgium. Expected to be completed in three years, the plant is designed to supply petroleum products—high grade gasoline, kerosine, fuel oil and automotive and industrial diesel fuel—for Jersey's affiliates in Belgium, the Netherlands and Luxembourgh.

Imperial Oil Will Build Refinery Near Winnepeg

Imperial Oil Limited has acquired a 400-acre site for a new refinery on the east bank of the Red River near Winnepeg, Man., Canada. Engineering plans are being completed, but it is not known when construction will start nor the capacity. Interprovincial Pipe Line Company's Edmonton, Alta. Can. to Superior, Wis., pipe line will supply the crude.

California Refining Plans Houdry Cat Cracking Unit

California Refining Company will include a 25,000 barrel per day Houdriflow catalytic cracking unit in its major construction program, recently announced for the Perth Amboy, N. J., plant. The new unit will be the first catalytic cracking installation for the company and the 77th Houdry-licensed catalytic cracking unit.

Magnolia Repairs Refinery

Clean up and repair work is under way at Magnolia Petroleum Company's recently damaged Fort Worth refinery and should be completed late this month. Explosion and fire damage was not as heavy as first thought, but the refinery's

COPPER ALLOY BULLETIN

CONDENSER AND HEAT EXCHANGER TUBING EDITION

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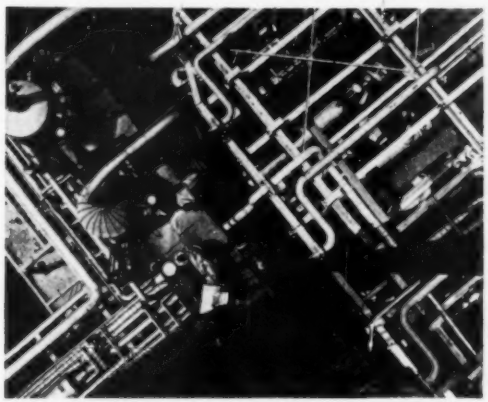
CONDENSER AND COOLER TUBE PROBLEMS

at Bayonne Tide Water Associated Oil Company Refinery

With processing operations maintained on a continuous basis for long periods, the problem of failure due to tube corrosion is a serious one. The shutdown of a single condenser or cooler may mean the closing down of the entire operation involving the loss of thousands of barrels of production. Every effort is made to keep going. Leaky tubes are plugged up and the equipment is kept in service as long as possible. Careful records are kept on some 800 condensers and heat exchangers to indicate when retubing is advisable.

Cooling Water Corrosive. Tide Water Associated Oil Company's biggest corrosion problem is to combat the corrosive action of the cooling water. Their Bayonne, New Jersey plant uses New York Harbor water for most of their cooling operations. It is drawn from the Kill van Kull between Staten Island and New Jersey near the New York Bay. A city sewer empties into the channel about 500 feet above the intake. In addition, sea shells, leaves, grass and other debris as well as silt and mud churned up by the propellers of passing ships, all contribute to contaminate the water. Revolving screens and secondary strainers are relied upon to prevent debris from entering the equipment. At present the refinery draws approximately 50,000 gallons of water per minute. Additional pumps now being installed will bring this up to about 100,000 gpm.



View of heat exchangers in T. C. C. unit at the Bayonne, N. J. Tide Water Associated Oil Company refinery.

Cooling water varies from 34°F in winter to 83°F in summer. Condensers and coolers are designed for a 77°F inlet water temperature and 110°F maximum water outlet.

The history and performance of condenser tubing used in a gasoline reflux condenser is typical.

Condenser contains 830 tubes, ¾" diameter, 16 BWG, 16 feet long.

Date	*History of Tubes*
July 1941	Admiralty placed in service.
June 1943	13 plugged.
March 1944	23 plugged
November 1944	15 plugged
June 1945	52 plugged
April 1946	Completely retubed with Admiralty.
August 1948	9 plugged
June 1949	Completely retubed with 70-30 Cupro Nickel.

Cupro Nickel Now Standard. For a number of years Admiralty tubes were standard, but about three years ago 70-30 Cupro Nickel replaced it because of its exceptionally fine performance in a unit such as this.

Hot fuel oil is drawn from the topping tower, passes through two stacked fuel oil cooler units entering the upper unit at approximately 435°F and leaving the lower unit at about 100°F. Cooling water enters the lower unit about 77°F and leaves upper unit at approximately 110°F. Both units contain 318 tubes, ¾" OD, 14 BWG, 16 feet long. Tubed with 70-30 Cupro Nickel in July 1941, the upper unit was retubed in May 1947 – a service period of 6 years – because of tube sheet and tube end corrosion. Up to that time no repairs of any kind were required. The lower unit is still in operation (8 years), with no repairs needed.

Duplex Offers Solution. Exceptionally corrosive conditions which are not solved satisfactorily with single-walled tubing such as D.E.A. (diethanolamine cooler) are being studied as possibilities for Duplex Tubing – steel or aluminum to the D. E. A. side and Admiralty or Cupro Nickel to the cooling water side.

No one alloy will serve every condition. Careful records of tube alloy performances are invaluable. Bridgeport Laboratory will be glad to work with operators to select the alloy best suited for specific operating conditions.

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operations were reduced to about half the normal rate.

Four Ample Areas Located For Synthetic Fuels Plants

Areas suitable for synthetic liquid fuel plants abound in the portions of four states according to two Bureau of Mines reports which covered two recent sample surveys including the following areas and raw materials: Western Kentucky, strip and underground coal; northwestern Colorado, oil shale and coal; southeastern Texas, natural gas; and southeastern Montana, strip coal. There will be ample raw materials and water for plants of large capacity even in semi-arid areas of the West. Furthermore, he said, abundant coal reserves were found available without resorting to the use of coking quality coals.

For copies write Publications Distribution Section, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13.

Phillips Petroleum Moves Pilot Plant Operations

Pilot plant operations conducted since 1939 at Phillips Petroleum Company's Hamilton plant, are being moved to the company's new proving station, west of Bartlesville, Okla. The Hamilton plant, located north of Bartlesville, was the company's first natural gasoline plant, completed in November, 1917, with an original capacity of 350 gallons a day extracted by a compression-type process.

The move, expected to be completed by the middle of October, will complete the centralization of all pilot plants of the Oklahoma area. The Burbank, Oklahoma, pilot plants were moved to the company's proving station two years ago. The proving station pilot plant operations started over a year ago and now include a modern internal combustion engine testing laboratory, devoted specifically to internal combustion engine test work. Larger scale pilot plant projects will continue at the Philtex experiment station, Phillips, Texas.

Richfield Oil May Try New Refining Process

A new refining process developed by The Lummus Company will be tried out at Richfield Oil Company's Watson, Calif., refinery, according to current reports. These reports say a contract has been awarded The Lummus Company for a 100-barrel-per-day continuous contact coking unit for the refinery. Richfield officials had "no statement at this time."

Membership Expansion

Gulf Coast Refiners Association has voted to expand the organization to include as associate members, refiners from any part of the country who express an interest in the association's aims and objectives. Heretofore, the association had included only Gulf Coast refiners. Harry Leyendecker of Eastern States Petroleum Company, Houston, has been named chairman of the membership committee.

Instrument Society Meet Displays Many Exhibits

The fourth national Instrument Society of America conference and exhibit, held in St. Louis last month, displayed more than 150 exhibits of practically all types of industrial and scientific instruments. While instruments are not considered heavy equipment, about 150 tons of motor, rail and air freight was involved in setting up these exhibits. The five-day conference was sponsored jointly by the Instrument Society of America, the Industrial Society of Mechanical Engineers, the American Institute of Physics, the Instruments and Measurements Committee of the American Institute of Electrical Engineers, the Institute of Radio Engineers, the National Telemetering Forum, and the Scientific Apparatus Makers Association.

Speakers included W. T. Nichols, director of the general engineering department, Monsanto Chemical Company; Dr. A. O. Beckman, president National Technical Laboratories, Pasadena, Calif.; Dr. Charles A. Thomas, executive vice president, Monsanto Chemical Company and president of the American Chemical Society; and Charles S. Redding, president of the Scientific Apparatus Makers Association and president of Leeds & Northrup Company.

Houdry Unit Change Being Made at Cleveland

Work was begun last month for a catalyst change at the Houdry unit of The Standard Oil Company's (Ohio) refinery in Cleveland, Ohio. This project, which is being performed by Catalytic Construction Company of Philadelphia on a firm basis, will be done on three cases at a time at the nine case unit, and is expected to be completed in nine weeks.

The plant has type C 17 cases with the original tube pattern. It is the third Houdry case turnaround Catalytic Construction Company has performed for Sohio in Cleveland.

Continental's Gaso Plant Set for November Opening

Completion date has been set for November 1 for Continental Oil Company's natural gasoline plant being constructed cooperatively by 23 operators in the Deep Todd pool in Crockett County, West Texas. Continental was selected as the plant operator by the other participants when work on the cooperative project began a year ago.

The completed gas recovery plant will have a daily capacity of 60,000 gallons and will handle all of the gas produced in the pool.

UOP Purchases Acreage

Universal Oil Products Company, Chicago, has purchased 600 acres of land between Shreveport and Mooringsport, La., on the Kansas City Southern railroad. Definite plans as to what type of building is proposed, the cost and the purpose of the building are expected to be announced by October 15.

Refining Census Report

"Census of Manufacturers 1947—Petroleum and Coal Products" which has been issued by the Census Bureau of the Commerce Department gives tables which summarize statistics on petroleum refining including coal products, employment, pay rolls, cost of materials, value added by the manufacture, inventories, capital expenditures, and the quantity and value of products shipped and important materials consumed. This report is the first such taken since 1939.

Write Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for Report MC29, "Census of Manufacturers 1947—Petroleum and Coal Products."

Better Refining Methods Are Predicted from Urea

Improved refining techniques are promised from the use of urea, one of the oldest synthetic organic chemicals, in petroleum analysis, according to chemists from Whiting Research Laboratory of Standard Oil Company (Indiana).

Included among the possible applications are elimination of low octane number constituents of gasoline, concentration of high octane number components of gas oils and lowering to the pour point of lubricating oils.

Marbon Chemist Appointed

Dr. Alfred G. Susie, chief chemist at Marbon Corporation, Gary, Ind., for the past four and a half years, has been appointed supervisor of plastics research at Armour Research Foundation of Illinois Institute of Technology. Dr. Susie will be in charge of research projects dealing with plastics in the chemistry and chemical engineering department of the foundation.

New Continental Officials

W. C. MacMillan has been elected executive vice president of Continental Oil Company, Serge B. Jurenev, vice president in charge of coordinating and planning, and Rawleigh Warner, Jr., secretary to succeed Jurenev.

MacMillan has been with Continental Oil Company for more than 20 years, Jurenev joined the company in 1942, whereas Warner, former assistant to the treasurer of the company, came to Conoco only last year.

Chemistry Department Head

Dr. James P. Fugassi, professor of chemistry at Carnegie Institute of Technology, Pittsburgh, has been appointed acting head of the department of chemistry. Before joining the CIT staff as instructor in chemistry in 1935, he had served as a research assistant at the University of Wisconsin.

Deaths

Donald Campbell Bakewell, 61, sales vice president of Blaw-Knox Company, died September 17 at his summer home in Hyannisport, Mass. He joined Blaw-Knox Company in 1937. From 1917 to 1930, he was president of Duquesne Steel Foundry Company of Pittsburgh and until 1937 was first vice president of the merged successor company, Continental Roll & Steel Foundry.

W. Emmett Bittner, vice president, purchases of Diamond Alkali Company, Cleveland, O., died September 2 in Pittsburgh, following an operation August 2. Bittner, 52, spent his entire business life with Diamond Alkali.

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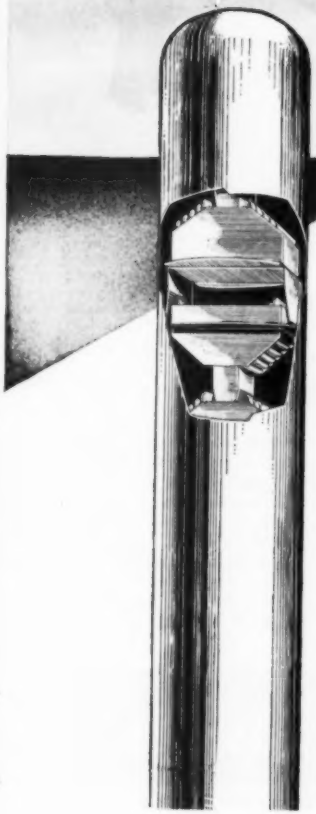

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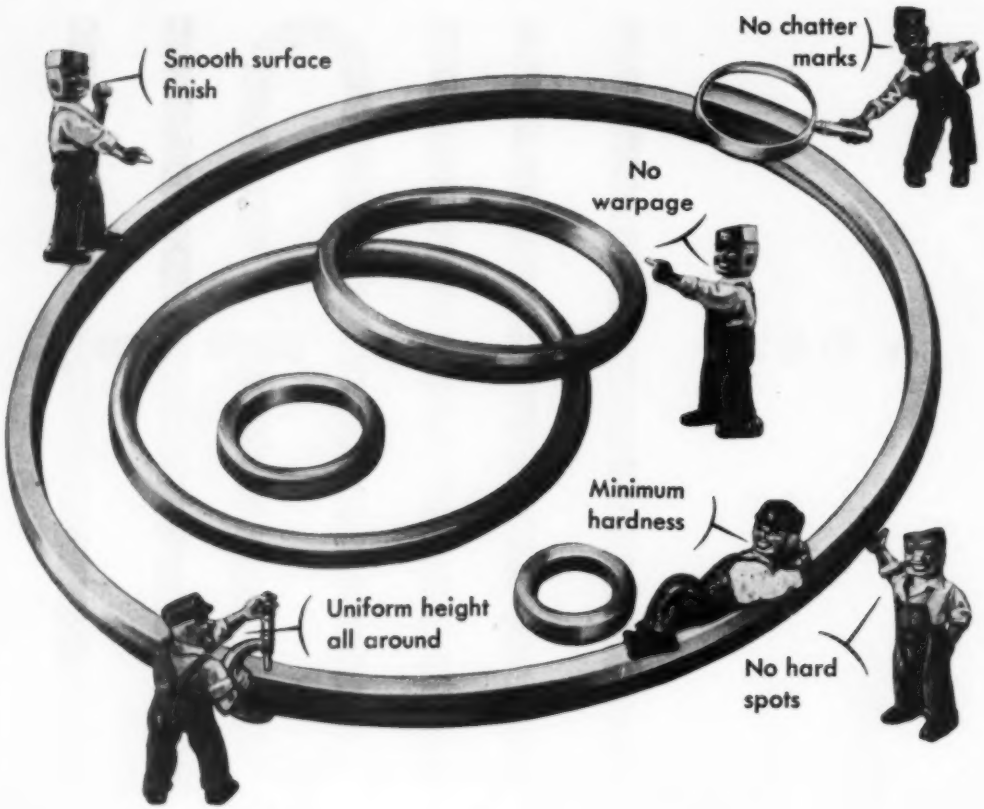

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SCIENCE and TECHNOLOGY Abstracts

Fundamental Physical and Chemical Data

DR. E. H. LESLIE and DR. E. B. COATS

Isobaric Heat Capacity of 1-Butene and 1-Pentene at Bubble Point. W. G. SCHLINGER AND B. H. SAGE. *Ind. End. Chem.*, **41** (1949) pp. 1779-82.

Information at present available on the heat capacity of 1-butene and 1-pentene in the liquid phase is limited to measurements at temperatures below 70° F. The authors studied the isobaric heat capacity at the bubble point of 1-butene and 1-pentene at temperatures from 90 to 200° F. Measurements were made in the two-phase region in a constant-volume adiabatic calorimeter. The isobaric heat capacity at the bubble point was calculated from the directly measured isochoric values by use of supplementary volumetric data. These data were obtained experimentally for 1-butene and were estimated from the law of corresponding states for 1-pentene. Results are given in detail in tabular and graphical form. A bibliography of nine references is included.

Volumetric Behavior of Propene. P. S. FARRINGTON AND B. H. SAGE. *Ind. Eng. Chem.*, **41** (1949) pp. 1734-7.

Experimental data pertaining to propenes are scattered and incomplete, except for a recent article by Vaughan and Graves, who studied the effect of pressure and temperature on the specific volume of propene at pressures up to approximately 1200 pounds per square inch and temperatures up to 573° F. In the present study the authors investigated the volumetric behavior of propene at temperatures from 40° to 460° F. and at pressures up to 10,000 pounds per square inch absolute and down to pressure below the vapor pressure at 40° F. The results of the work are presented in detail in tabular form and are compared graphically with the data obtained by other investigators. A bibliography of eight references is included.

Correction Factor for Latent Heat. R. R. DREISBACH. *Ind. Eng. Chem.*, **41** (1949) pp. 1749-50.

The author developed a method for calculating the Hagenmacher correction factor for latent heats, using a modified Antoine equation for vapor densities and the law of rectilinear diameters for liquid densities. The method eliminates the necessity for having critical data and uses instead boiling point and liquid density data. Values are calculated for hexane, heptane, benzene and chlorobenzene and are presented in tabular form. Comparison is made between values calculated by the author's method, determined values and the values of Hagenmacher. A bibliography of six references is included.

Vapor-Liquid Equilibria of Hydrocarbon Systems above Atmospheric Pressure. EDWARD GELUS, STANLEY MARPLE, JR., AND M. E. MILLER. *Ind. Eng. Chem.*, **41** (1949) pp. 1757-61.

Data on hydrocarbon systems such as are encountered in petroleum refining are highly inadequate, particularly above atmospheric pressure. The investigation here reported was undertaken for the purpose of developing a suitable apparatus and obtaining necessary data, particularly for use above atmospheric pressure. A steel recirculation apparatus equipped with automatic pressure control was constructed. This was suitable for obtaining equilibrium vapor and liquid compositions up to 500 psi. gage. Data are presented for the system 2,2,4-trimethylpentane-toluene at 14.7, 29.7, and 59.7 psi. absolute. This particular system is useful for testing continuous fractionating columns over a wide range of liquid-vapor ratios. Data are also presented at atmospheric pressure for 2,2,4-trimethylpentane and methylcyclohexane. This system is useful for testing columns of high theoretical number of plates. A bibliography of eight references is appended.

High Pressure Vapor Liquid Equilibria. K. A. SMITH AND K. M. WATSON. *Chem. Eng. Progress*, **45** (1949) pp. 494-507.

Generalized correlations are given for vapor-phase and liquid-phase activity coefficients that express deviations from the laws of ideal solutions in two phase mixtures at high pressure. The activity coefficients are used in conjunction with thermodynamic equilibrium constants derived from modified definitions of the standard states of unit activity proposed by Gamson and Watson. These constants were developed for wider ranges of conditions and require less correction than those previously available.

Correlations can be used to approximate the equilibrium vaporization ratio y/x for any component at conditions up to the true critical point and in the region of retrograde condensation. Deviations from experimental data for the paraffins are approximately 15 percent for 184 comparisons selected at random and including 86 components at the true critical points of mixtures. The use of equilibrium constants without the activity coefficients results in a mean error of 216 percent for the same comparisons. Vapor and liquid compositions, dew points, and bubble points can be calculated by reproducible methods with accuracy sufficient for most purposes.

Although the correlations were developed for mixtures of paraffin hydrocarbons, it is probable that they can be applied to other reasonably ideal systems. They can also be used as a basis for developing correlations applicable at high pressures for the activity coefficient itself, these to express deviations attributable to chemical dissimilarity.

A Correlation of Viscosity, Temperature, and Pressure. R. T. SANDERSON. *Mech. Eng.*, **71** (1949) p. 349.

Experiment indicates that pressure and temperature have equivalent effects on kinematic viscosity. This relationship can be expressed by the equation $VP = 4718.83 - 1701.54 \log T$, in which P is the pressure in psi. and T the temperature in degrees Rankine. A pressure scale can be superimposed upon part of the present temperature scale of the A.S.T.M. chart, so that the kinematic viscosity produced at any given pressure at constant temperature can be determined from the chart; the relation is at least approximately correct for lubricating oils. The general observation that oils having low viscosity-temperature coefficients also have low viscosity-pressure coefficients is thus quantitatively confirmed.

Infrared Absorption Spectra of Some Cyclopropane and Cyclobutane Hydrocarbons. JOHN M. DERFER, EDWARD E. PICKETT AND CECIL E. BOORD. *Jour. Am. Chem. Soc.*, **71** (1949) pp. 2482-5.

The infrared absorption spectrograms of fourteen cyclopropane hydrocarbons and seven cyclobutane hydrocarbons

These abstracts from the current literature of science and technology (not including trade journals easily available) were prepared by Drs. Leslie and Coats of The Leslie Laboratories, Traver Road, Ann Arbor, Mich., which will supply, at cost, photostatic copies of original articles. Complete or limited bibliographies covering special topics by title, by abstracts, or in complete manuscript, also may be had by arrangement with the Laboratories.

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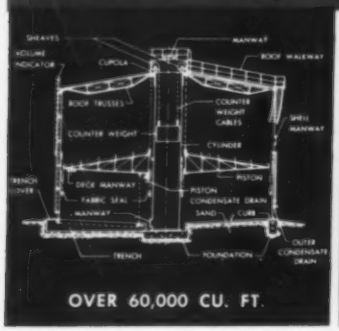

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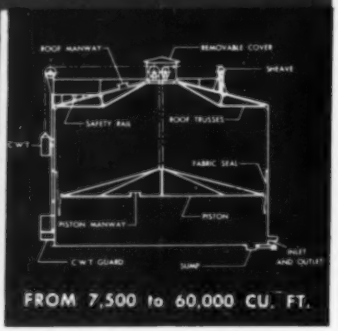

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were determined. A prominent absorption band peaked at about 9.9 μ was noted in the spectra of all of the cyclopropanes examined and similarly, a pronounced band peaked at 11.0 μ was noted in the spectra of all the cyclobutanes. These bands may be useful in identifying ring structures such as these. Data are presented in tabular and graphical form.

Distribution of Ketones in Water-Hydrocarbon Systems. Robert E. Treybal and Otto J. Vondrak. *Ind. Eng. Chem.*, **41** (1949) pp. 1761-3.

Recent developments in the synthesis of liquid fuels from natural gas has rendered it important to extend our knowledge of the equilibria between hydrocarbons, various oxygenated compounds, and their aqueous solutions. The authors present data for acetone and methyl ethyl ketone distributed between water and n-hexane and n-heptane. Equilibrium solubility curves and tie lines were determined at 25° C. for four ternary systems. The data are presented in detailed form in tables and graphs, and a bibliography of six references is included.

Chemical Composition and Reactions

Carbon Aralkylations of Nitro Paraffins. H. B. Hass, E. Janet Berry and Myron L. Bender. *Jour. Am. Chem. Soc.*, **71** (1949) pp. 2290-1.

One approach to the synthesis of the t-carbinamines is the alkylation of nitro paraffin salts followed by reduction of the nitro compounds produced. A series of seven nitro paraffin salts were treated with p-nitrobenzyl chloride, forming carbon-alkylation products in every case. The dinitro compounds were then reduced to the corresponding diamines by means of high pressure catalytic hydrogenation. The compounds made are of particular importance as sympathomimetic drugs because they cannot be deaminated in the body by the usual mechanism involving oxidation to the imine and subsequent hydrolysis. The properties of the compounds are presented in tabular form.

Action of an Alcohol on Perfluorocyclobutene. J. D. Park, M. L. Sharrah and J. R. Lacher. *Jour. Am. Chem. Soc.*, **71** (1949) pp. 2337-9.

The reaction of alcohols with hexafluorocyclobutene in the presence of a base, resulted in the formation of 1,2-dialkoxy - 3,3,4,4 - tetrafluorocyclobutenes. The physical properties of these ethers, along with their ultraviolet and infrared absorption spectra, are reported.

Manufacture: Processes and Plant

Mass Transfer in the Flow of Liquids Through Granular Solids. Merk Horson and George Thodos. *Chem. Eng. Progress*, **45** (1949) pp. 517-24.

The investigation was aimed at the determination of a mass-transfer factor for liquids flowing through granular beds. The experimental technique used for gas

film studies was successfully adapted to the study of mass transfer from the surface of porous solids to liquid media flowing through the bed. The mass-transfer coefficients for the experimental systems studied correlated as linear functions of the modified Reynolds number over the range of the experiments. Separate correlations were made for each system and for each particle diameter. Coefficients varied approximately as the 0.23 power of the modified Reynolds number. Expressions are given for a generalized mass transfer factor for fluids. Data are presented in detail in tabular and graphical form and a bibliography of 14 references is included.

Film Coefficient of Condensing Vapor. Ju Chin Chu, R. K. Flitcraft, and M. R. Holeman. *Ind. Eng. Chem.*, **41** (1949) pp. 1789-94.

The investigation covered a modified method of measuring the heat transfer coefficient of a condensing organic vapor on a single horizontal tube. The author states that the method of Wilson is not fundamentally sound in that it assumes that the heat transfer coefficient is independent of the rate of heat transfer. It is shown theoretically that the heat transfer coefficient is a function of the rate of heat transfer; therefore, the correlation of data obtained at a constant value of rate of heat transfer will place Wilson's method on a rigorous basis. Experimental conditions of rate of water flow and over-all temperature difference were varied so that data were obtained at a constant rate of heat transfer under two or more conditions. The experimental values of the heat transfer coefficient obtained at low rates of heat transfer were found to check those calculated from the Nusselt equation. The deviation of the experimental values from the calculated values increase as the rate of heat transfer increases. This may indicate turbulence in the condensate flow at high rates of heat transfer. Theoretical derivation of the relationship of the heat transfer coefficient and the rate of heat transfer was confirmed by experimental work using ethyl acetate and benzene. Detailed presentation of the data in tabular and graphical form is given and a bibliography of 14 references is included.

Cracking of High Sulfur Stocks. A. L. Conn and C. W. Brackin. *Ind. Eng. Chem.*, **41** (1949) pp. 1717-22.

In cracking high sulfur stocks with natural catalyst, the catalyst becomes poisoned rapidly, and this results in high coke and gas yields at the expense of gasoline yield. It was found that steam can be used to solve the problem. In one instance the introduction of steam into the regenerated catalyst standpipe serves to hydrate the catalyst prior to contact with oil, and prevented loss of catalyst selectivity. In a further set of experiments, including one full-scale plant test, the use of large quantities of stripping steam in addition to the hydration steam made it possible to restore poisoned catalyst to normal selectivity. The authors conclude that the rate of sulfur poisoning is dependent upon the extent to which the catalyst is hydrated at the time it comes in contact with the oil, upon the concentration of sulfur in the feed, and upon the extent to which the poison is

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Science and Technology

eliminated by replacement with steam as the catalyst passes through the stripper. Data secured in the work are presented in considerable detail in tabular and graphical form. A bibliography of five references is included.

Polymerization of Olefins in Presence of Dihydroxyfluoboric Acid. J. W. Brooks. *Ind. Eng. Chem.*, **41** (1949) pp. 1694-6.

Among the common and widely used polymerizing catalysts for olefins such as propylene, butenes and pentenes are phosphoric acid, sulfuric acid and copper pyrophosphate. The present article describes the copolymerization of olefins in the presence of dihydroxyfluoboric acid. With the use of this catalyst operating conditions are milder than those required with the previously mentioned catalysts. The catalyst was used for the copolymerization of propylene with isopentene, propylene with isobutene, 1-butene with isobutene, 2-butene with isobutene, and mixed n-butenes with isobutene at temperatures from 0 to 40° C. and pressures of 50 to 125 psi. Polymers are hydrogenated, fractionated, and analyzed by infrared absorption. Copolymerization of propene with isobutene and hydrogenation of the product yielded a material containing 67 percent of a heptane cut. The heptane cut was found to be 95 percent 2,3-dimethylpentane. The octane fraction of the hydrogenated propene-isopentene copolymer represented 66.4 percent of the total product and was composed of 54.8 percent 2-methyl-3-ethylpentane, 42.5 percent 3,4-dimethylhexane, and 2.7 percent of unidentified hydrocarbons. The octane fraction of the hydrogenated polymer produced from 2-butene and isobutene consisted entirely of trimethylpentanes; the octane fraction of the hydrogenated 1-butene-isobutene polymer contained 34 percent dimethylhexanes and 66 percent trimethylpentanes.

High Pressure. A Chemical Engineering Report. *Chem. Eng.*, **56** (1949) pp. 107-23.

The article is a survey of the current status of high pressure techniques and includes consideration of the applications and use of high pressures and the engineering knowhow and design of equipment for high pressure processing. Design of vessels and reactors and separators for high pressure is discussed. Heat exchangers for high pressure are considered. Closures and valves are reviewed and instrumentation is given some consideration. The article is well illustrated with detailed drawings showing various types of construction.

Fluid Catalyst Cracking with Silica-Magnesia. R. W. Richardson, F. B. Johnson and L. V. Robbins, Jr. *Ind Eng. Chem.*, **41** (1949) pp. 1729-33.

The two catalysts that have been employed in fluid catalytic cracking and natural clay and synthetic silica-alumina. The latter is especially adapted for the production of high octane and volatile gasoline plus large yields of butanes and butenes. A new type of catalyst, synthetic silica-magnesia of the gel type, is designed primarily for motor gasoline production. Development and pilot plant testing of this catalyst is described. The gasoline octane numbers are lower than those obtained with silica-alumina, but approach those obtained with natural catalyst. Silica magnesia is superior from the standpoint of activity maintenance. The catalyst is now commercially produced. Data are presented in considerable detail in tabular and graphical form.

Design of Thick-Walled Pressure Vessel Shells. R. R. Maccary and R. F. Fey. *Chem. Eng.*, **56** (1949) pp. 124-27.

The article is the first of a series to be published discussing the design of thick-walled vessels for high pressures. The most widely accepted formulas for thick-walled vessel design are reviewed. Design charts are given for the wall thickness of a cylindrical shell based on the Lamé equation and for the wall thickness of a cylindrical shell based on the distortion energy equation.

Design and Construction of a Petroleum Refinery Laboratory. C. N. Sjogren and J. M. Deal. *Ind. Eng. Chem.*, **41** (1949) pp. 1657-64.

The article considers laboratory design problems as related to the petroleum industry. This laboratory was designed to handle all of the test work for a refinery having a capacity of 50,000 barrels of crude oil per day and also to analyze a large proportion of the samples originating in the research department. The general construction of the building is described and floor plans are given. The article is illustrated with numerous pictures showing laboratories for different purposes.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

Vinyl propenyl ketone
Vinyl allyl ketone
Vinyl iodide
Tridecamethylene bromohydrin
2,4-Heptadiene-6-one
2,2-Diquinolyl
Dipropenyl ketone
1,3-Dimethyl-1,3-diphenylcyclobutane
Dimethyl dichloromaleate
Diallyl ketone
Benzene pentacarboxylic acid
3-Bromo-2-chloro-1-propene
Cyanogen
Cyclobutane
p-Fluoroaniline
2-Methyl-5-aminopropiophenone
3-Methyl-5-aminopropiophenone
2-Methyl-5-nitropropiophenone
3-Methyl-5-nitropropiophenone
2-Methyl-5-hydroxypropiophenone
3-Methyl-5-hydroxypropiophenone

Products: Properties, Utilization and Analysis

Chemistry of Gum Formation in Cracked Gasoline. E. L. Walters, H. B. Minor, and D. L. Yarnoff. *Ind. Eng. Chem.*, **41** (1949) pp. 1723-9.

The stability of gasoline is measured by the length of time the gasoline will remain stable in storage before it forms objectionable quantities of gums and peroxides. The permissible level of oxidation of gasoline is low, about one-tenth of that reported for lubricating oils. Studies were made of the stability of cracked gasolines and pure hydrocarbons by measuring the rates of gum and peroxide formation on aging. Gum originates from oxidation of reactive hydrocarbons and gasoline impurities, such as nonhydrocarbons. Products that form gum were found to be more difficult to inhibit against oxidation than those that form only peroxides. The stability of cracked gasoline was improved by treatment, inhibition, or dilution with straight-run components. Boiling range is an important factor. Metal catalysts reduced gum stability, but were found capable of complete inactivation of metal deactivators. Factors that influence anti-oxidant and deactivator behavior are discussed. The activation energies of gum-formation reactions were altered by antioxidants and by metal catalysts. Data are presented in detail in graphical form and a bibliography of 25 references is included.

The Properties of Hydrocarbon Gas-Turbine Fuels. D. A. Howes and H. C. Rampton. *Jour. Inst. of Petroleum*, **35** (1949) pp. 419-35.

The properties of fuels for gasoline engines and diesel engines have been fairly well established. In the case of the aero gas turbine, however, the position is not so satisfactory. Although the turbine appears to be basically less exacting in its fuel requirements than the internal-combustion engines, it is probable that for some time to come, gas turbines will not be able to operate with full satisfaction on a wide range of fuels, particularly when used in aircraft. The authors summarize the information available on the properties of hydrocarbons boiling within the range 65 to 300 degrees C. with particular reference to their use as components of fuels for gas turbines. In general these properties are determined by chemical composition and configuration, and lie mostly between the extremes set by the paraffins on the one hand, and the aromatics on the other. Available information on the hydrocarbon compositions of petroleum, Fischer-Tropsch fuel, and shale-oil fractions is summarized. Attention is drawn to the present lack of knowledge of hydrocarbons boiling above the gasoline range. Available methods of analysis are briefly reviewed, and the possibilities of synthetic methods for producing gas-turbine fuels of different hydrocarbon compositions are summarized.

Chemicals from Hydrocarbon Synthesis. T. O. Eliot, C. S. Gorbin, Jr., and P. S. Pace. *Chem. Eng. Progress*, **45** (1949) pp. 532-6.

The authors describe the quantities and distribution of the chemicals produced by a representative hydrocarbon synthesis plant and consider some of the problems in separating and refining the materials into marketable products. Although the synthesis process, as modified in the United States, is designed primarily for

maximum yields of liquid hydrocarbons, significant amounts of aliphatic oxygenated compounds are obtained as by-products. Although these chemicals generally are less than one-quarter of the total volume of salable products, their potential market value can exceed that of the liquid hydrocarbons produced. Compounds fall in the classes alcohols, aldehydes, ketones, and acids.

Determination of Impurities in n-Heptane Concentrates. JAMES A. ANDERSON, JR., AND CHARLES E. ZERWEKH, JR. *Analytical Chem.*, **21** (1949) pp. 911-14.

The production of reference fuel grade n-heptane by distillation of available refinery virgin naphthas is difficult because of the presence in the naphtha of two compounds, cis-1,2-dimethylcyclopentane and 2,2,4-trimethylpentane, which boil within 1.5° F. of n-heptane. In connection with experimental studies on the production of referenc fuel grade n-heptane of 99 percent or better purity by fractional distillation, an infrared procedure was developed for determination of the individual impurities present in n-heptane concentrates of high purity, that is 90 to 99 percent. The impurity components determined by the analysis are 2-methylhexane, 3-methylhexane, trans-1,3-dimethylcyclopentane, trans-1,2-dimethylcyclopentane 2,2,4-trimethylpentane, cis-1,2-dimethylcyclopentane, and methylcyclohexane. The analysis requires approximately 2 hours. The method has an average accuracy for individual impurities of ±0.2 percent, based on the total sample. Results for total impurities check by the freezing point methods to within ±0.3 percent.

Rapid Estimation of Ethylenes. R. W. MARTIN. *Analytical Chem*, **21** (1949) pp. 921-2.

The author describes a rapid procedure for the determination of styrene and certain of its homologs with an accuracy of ±0.5 percent. The method is based on the reaction of an excess of mercuric acetate in methanol solution with an ethylenic double bond. One mole of acetic acid is liberated for each ethylenic bond. The acid liberated is titrated directly with standard sodium hydroxide after the addition of an excess of sodium chloride. The application of the method to fifteen ethylenic compounds is indicated. Typical results are presented in tabular form. Substitution, which often occurs when halogens are added to ethylenes, is avoided.

Analysis of Hydrocarbon Mixtures. H. E. MORRIS, W. H. LANE, AND R. B. STILES. *Analytical Chem.*, **21** (1949) pp. 908-9.

Styrene is commonly made by the catalytic dehydrogenation of ethylbenzene, which in turn is produced by the catalytic alkylation of benzene with ethylene. The alkylate, containing benzene, ethylbenzene, diethylbenzene, and higher polyethylbenzenes, is fractionally distilled to recover ethylbenzene of high purity. It is important that the diethylbenzene content of the product be kept at the lowest possible value. The authors present a simple analytical procedure developed for the analysis of ethylbenzene containing small amounts of benzene and diethylbenzene. The procedure can be handled by laboratory technicians and is based on the influence of minor components on the boiling range of the mixture where the minor components boil at temperatures considerably removed from the boiling point of the main component. The apparatus is described and the results of its typical application are given in tabular form.

Benzene, Toluene, Ethylbenzene, o-Xylene, m-Xylene, and p-Xylene. D. D. TUNNICLIFF, R. ROBERT BRATTAIN, AND L. R. ZUMWALT. *Analytical Chem.*, **21** (1949) pp. 890-4.

The determination of the individual C_6, C_7, and C_8 aromatics by chemical methods is difficult because of the similarity in the chemical properties of these compounds. Fortunately, their ultraviolet absorption spectra differ sufficiently to permit an accurate determination of each component. A method is presented by the authors for the determination of these aromatic hydrocarbons. The accuracy of the determination for each component is about 1 percent of the total aromatic content, except for toluene and ethylbenzene, which are determined to about 2 percent when both are present in the same sample. Tests for detection of the presence of interfering components are given. A chemical treatment is described that is effective in removing many interfering unsaturated and sulfur compounds. The apparatus and procedure are described in some detail and typical results are presented in tabular form. A bibliography of 12 references is included.

Total Phenols in Gasolines and in Cresylic Acids. M. J. MURRAY. *Analytical Chem.*, **21** (1949) pp. 941-5.

Cracked gasolines usually contain small quantities of phenolic compounds. The author describes a spectrophotometric method for the determination of total phenols in small samples of gasoline. The phenols are extracted with aqueous sodium hydroxide and the transmittance of the extract is measured at 290 mμ, at which point phenolates have a strong absorption maximum. An approximate, empirical, specific extinction coefficient of 24 is used for the composite of phenols in gasoline when an actual value cannot be determined. Thiophenols are included in the total in the absence of large amounts of alkyl mercaptans, their concentration can be roughly estimated from a transmittance measurement of the caustic extract at 265 mμ. Compounds such as nitrogen bases, carboxylic acids, hydroperoxides, and alkyl mercaptans do not affect the determination. Data are presented in considerable detail in tabular and graphical form and a bibliography of four references is included.

Identification of Pennsylvania Lubricating Oils by Infrared Absorption. MARK FRED AND RICHARD PUTSCHER. *Analytical Chem.*, **21** (1949) pp. 900-11.

It has been known, as a result of studies conducted for the Pennsylvania Grade Crude Oil Association, that all oils made from Pennsylvania grade crudes show a characteristic infrared absorption band at 10.3 microns. This band, with minor exceptions, is not found in oils made from crudes in other parts of the country. The band was examined intensively for natural distribution and for interpretation in terms of the type of compound producing it. Evidence of the existence of olefins in certain sources of crude petroleum is presented. These olefins were identified by means of a characteristic infrared absorption band at 10.3 microns. The carbon atoms of olefin bond are alkylated with methyl groups, or other groups that are aliphatic for at least the first two carbon atoms adjacent to the double bond. The

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number of double bonds is roughly constant and is approximately 1 percent of the total carbon-carbon bonds as a function of boiling point from gasoline to heavy cylinder stock. When the oils are chemically treated by bromination, catalytic hydrogenation, or silica gel adsorption, the behavior is found to be that expected for olefins. These olefins were found in all crudes examined from the Pennsylvania field, but not in other crudes, with the exception of a very few nearby fields of mixed crude type. They are easily observable in finished lubricating oil, and their absence from an oil is evidence that they did not originate from Pennsylvania grade crude. It is especially noteworthy that the band does not appear in certain Texas oils that have physical characteristics similar to oils from Pennsylvania. The data are presented in considerable detail in tabular and graphical form and a bibliography of 18 references is included.

The Beaker-Corrosion Test for Lubricating Oils. F. W. H. MATTHEWS. *Jour. Inst. of Petroleum*, **35** (1949) pp. 436-53.

The author describes a laboratory test for evaluating the corrosive potentialities of lubricating oils towards cadmium-nickel bearing metal. The work provides a "background picture" for the work at present being done by I.P. Sub-committee No. 6 on corrosion tests for automotive lubricants. The experimental work is described in some detail. Its object was to provide a test of suitable precision which at the same time would yield results correlating with those obtained by the Bristol single-cylinder Hercules engine test. The test finally adopted yielded reproducible results showing reasonable correlation with engine tests. The apparatus and the procedure are described fully, with explanatory diagrams and photographs.

Cunningham ASME Nominee

James D. Cunningham, president of Republic Flow Meters Company, of Chicago, is the 1950 nominee for president of The American Society of Mechanical Engineers. Other new officers, include four regional vice presidents and two directors-at-large, submitted by the nominating committee during the society's semi-annual meeting at the University of California Extension Building in San Francisco. Nomination is tantamount to election. Cunningham would succeed James M. Todd, consulting engineer of New Orleans.

Formal election will take place in the fall by letter ballot of the membership, which totals more than 25,000 engineers throughout the United States.

Bahrein Announces Changes

John F. Purcell has been promoted to chief engineer, and Leigh D. Josephson has been appointed superintendent of personnel of The Bahrein Petroleum Company Limited at the Bahrein, Persian Gulf refinery. Purcell succeeds Carroll A. Southwell who is now on assignment with California Texas Oil Company Limited in Holland. Josephson, whose former position was assistant refinery superintendent, has been stationed at Bahrein since 1930.

Digest of Recent U. S. PATENTS Pertaining to PETROLEUM REFINING

Compiled by HEINZ HEINEMANN

(From the Official Gazette, July 12, 19, 26 and August 2, 9, 1949)

REFINING

U.S.P. 2,475,828. Recovery of Naphthene Hydrocarbons. A. Farkas and A. F. Stribley, Jr. to Union Oil Company of California.

Pure dialkylated naphthenes are separated by fractionation from a hydrocarbon mixture also containing paraffins of the same boiling range as these naphthenes to obtain a narrow boiling fraction containing essentially only the cis type of geometric isomer of the dialkylated naphthenes together with paraffins, and a second narrow boiling fraction containing essentially only the trans type of these naphthenes together with paraffins. At least one of these two fractions is isomerized to convert its naphthenes to the other geometric isomer and thereby to effect a change in the b.p. of these naphthenes. The isomerized product is distilled to separate the isomer formed from the paraffins in the mixture.

U.S.P. 2,475,957. Treatment of Natural Gas. F. E. Gilmore to Phillips Petroleum Company.

Natural gas is freed from a nitrogen impurity by a particular process comprising compressing and cooling the gas and then subjecting it to repeated indirect heat exchange with refrigerated vaporized and liquid methane, respectively, and with vaporizing liquid methane.

U.S.P. 2,475,990. Separation of Hydrocarbons. A. E. Robertson to Standard Oil Development Company.

A liquid mixture of iso-octane and n-heptane is contacted with a diaphragm of heated vulcanized rubber, e.g. a rubber tube. N-heptane diffuses through this diaphragm. The diffused, vaporized n-heptane is condensed and thus separated from the iso-octane.

U.S.P. 2,476,010. Rectification. J. V. Whittlesey to Standard Oil Development Company.

Details are claimed of a process for the fractional distillation of complex hydrocarbon mixtures containing constituents of lower vapor pressure than water. An aqueous material is introduced into the upper portion of the fractionating tower into direct intimate contact with condensible vapors passing into this zone from below.

U.S.P. 2,476,308. Water-in-Oil Type Emulsion. D. X. Klein to E. I. du Pont de Nemours & Company.

A water-in-oil emulsion is formed from benzene, gasoline, lubricating oil, or similar hydrocarbons by using as emulsifying agent between 0.02-3 percent (based on the total weight of the emulsion) of a polymer of an alkyl-siliconic acid of the formula R-SiO·OH wherein R is an alkyl radical of 12-28 C atoms.

U.S.P. 2,476,280. Apparatus for the Distillation and Fractionation of Composite Liquids and Control Means Therefor. L. B. Bragg, C. A. Schwarzler, and C. J. Brown to Foster Wheeler Corporation.

Details are claimed of an apparatus for the batch distillation and fractionation of composite liquids such as hydrocarbon oils.

U.S.P. 2,476,417. Decolorization of Petrolatum Stocks. W. M. Jarnagin to Attapulgus Clay Company.

A petrolatum stock is contacted for decolorization first with air at a temperature of 250-400° F. for ½-4 hours. The thus oxidized stock is contacted with a decolorizing adsorbent, such as thermally activated bauxite, at a temperature such that the oxidized stock is in a fluid state (about 180-220° F.).

U.S.P. 2,476,472. Separation of Ethylene from Gaseous Mixtures. M. H. M. Arnold and D. Baxter to Imperial Chemical Industries, Ltd.

Gaseous mixtures containing ethylene are contacted with an adsorbent, such as active carbon, in a vessel throughout which the adsorbent moves unimpaired in a fluidized particulate state. At least a portion of the adsorbent ethylene is removed from the adsorbent in another vessel where the adsorbent is maintained as a boiling bed with a state of agitation higher than that of the adsorption bed.

U.S.P. 2,477,190. Naphthenic Acid Production. H. Linford and W. J. Baral to Union Oil Company of California.

Naphthenic acids are recovered from a petroleum fraction containing them by a method claimed in detail and making use of the formation, separation, and decomposition of the alkali metal soaps of said acids.

U.S.P. 2,477,220. Additive for Motor Fuels. J. L. Volz and K. J. Korpi to Union Oil Company of California.

A gasoline motor fuel contains, in addition to the lead alkyl anti-knock agent, organic sulfur compounds in an amount sufficient to retard the antiknock imparting properties of the lead alkyl, and 0.01-0.5 percent of an arsenite of an alcohol of the formula $R(OC_mH_{2m})_nOH$ in which m is an integer of 1-5, n an integer of 0-3, and R is hydrogen or an alkyl group.

U.S.P. 2,447,303. Azeotropic Distillation of Hydrocarbon Mixtures. G. R. Lake and J. M. Stribley to Union Oil Company of California.

A complex hydrocarbon fraction containing non-aromatic and aromatic hydrocarbons of the same boiling range is azeotropically distilled in the presence of a naphthenic hydrocarbon boiling below, but not more than 9° C. below, the aromatic components which are vaporized with the azeotrope former. Methyl and ethylcyclopentane are preferred naphthenic azeotrope formers.

U.S.P. 2,447,314. Process for Purifying Gases. W. G. Scharmann to Standard Oil Development Company.

Details are claimed of a process for removing weak acidic constituent impurities, such as carbon dioxide and hydrogen sulfide from gas mixtures.

U.S.P. 2,477,322. Solvent Extraction Process. E. F. Wadley to Standard Oil Development Company.

A hydrocarbon mixture boiling in the gasoline boiling range is mixed with liquid sulfur dioxide at a temperature of 0 to —100° F. The extract and raffinate phases formed are separated. The extract is washed with an olefinic polymer boiling in the range of 450-600° F. at a temperature of 0 to —100° F. to form a second raffinate and extract phase. The various phases are recovered to obtain the hydrocarbon components of the mixture.

U.S.P. 2,477,367. Recovery of Hydrocarbons. A. D. Garrison to Texaco Development Corporation.

Liquefiable hydrocarbons are recovered from a single phase hydrocarbon mixture at a pressure high enough that the mixture is subject to retrograde condensation upon a reduction in pressure. The process is based on the expansion of the mixture within the retrograde condensation range to obtain by the subsequent reduction in pressure and temperature the liquefaction of hydrocarbons. The expanded mixture is contacted with absorption oil to collect the hydrocarbons in the liquid phase.

U.S.P. 2,477,595. Fractionally Distilling in Alternate Heating and Cooling Zones. A. W. Goldsbarry to The Pure Oil Company.

A body of a liquid of wider boiling range, particularly of petroleum oil of lubricating oil boiling range, is maintained at vaporizing temperature in a vaporizing zone. Resulting vapors are passed upwardly through a fractionating

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zone where they and their condensate are subjected to a plurality of heating steps by indirect heat exchange with liquid from the vaporizing zone and to a series of cooling steps. The liquid used as heating medium is returned to the vaporizing zone while vapors withdrawn from the fractionating zone are condensed.

U.S.P. 2,477,671. Purification of Alkylation Mixtures. D. M. Warburton to Diamond Alkali Company.

A Friedel-Crafts reaction liquor containing dissolved and dispersed Friedel-Crafts organo-metal halide complex is passed through a bed of porous co-precipitated silica-alumina particles or other solid particles having adsorptive capacity. The said complex is adsorbed and thus separated from the purified liquor. The adsorptive capacity of the bed can be regenerated by washing with alkyl aryl sulfonate solution.

U.S.P. 2,477,715. Azeotropic Distillation of Styrene-containing Hydrocarbon Fractions. L. Berg and J. M. Harrison to Gulf Research & Development Company.

A mixture containing styrene and like-boiling non-styrene hydrocarbons is mixed with 1-nitropropane and then fractionally distilled in the presence of water. A distillate of an azeotropic mixture comprising water and non-styrenes is taken off and stratified into water and hydrocarbon layers. The water is returned to the upper part of the fractionating column and the fractional distillation is thus repeated until the greater part of the non-styrenes has been separated from the styrene oil.

U.S.P. 2,478,045. Stabilization of Butadiene with Salicylates. L. F. Hatch, D. E. Adelson, and B. O. Blackburn to Shell Development Company.

Butadiene-1,3 is stabilized with 0.01-0.1 percent by weight of a salicylate having a chain of not more than 6 C atoms attached to its carboxyl radical, e.g. methyl or phenyl salicylate. The additive not only prevents polymerization of the butadiene, but also prevents corrosion and rusting of ferruginous containers employed for the storage of the butadiene.

U.S.P. 2,478,299. Purification of Hydrocarbon Mixtures Containing Olefins and Diolefins. S. A. Miller to Celanese Corporation of America.

A conjugated diolefin is removed from a hydrocarbon mixture by first reducing the diolefin content to less than 8 percent by causing part of the olefin to react with sulfur dioxide and separating the sulfone formed. The remaining hydrocarbon mixture is heated to a temperature above 80° C. under a pressure such that the diolefin is in the liquid phase in the presence of at least 1.5 molecular equivalents (based on the remaining diolefins) of a di-ester of maleic acid or a di-ester of alkyl- or aryl-substituted maleic acids. The unreacted hydrocarbons are separated.

U.S.P. 2,478,456. Solvent Dewaxing. L. E. Boudreaux and O. R. Mitchell to Socony-Vacuum Oil Company, Inc.

Wax-containing petroleum oil is blended with a dewaxing solvent consisting of acetone, toluol and benzol in particular proportions, and a small amount of an alcohol or organic acid additive miscible with water but immiscible with oil. On chilling the mixture the wax is precipitated. The additive inhibits the formation of hard, adherent ice on the inner surfaces of the chiller from water contained in the mixture.

U.S.P. 2,478,472. Solvent Dewaxing. R. T. Edwards and R. B. Killingworth to Socony-Vacuum Oil Company, Inc.

Waxy constituents are separated from an oil by mixing the oil with an oil solvent comprising xylene hexafluoride.

U.S.P. 2,478,710. Method of Stabilizing Hydrocarbons. R. F. Robey to Standard Oil Development Company.

An unsaturated hydrocarbon is compounded for stabilization against oxidation and polymerization, with a liquid mixture of a naphthol and an alkyl catechol. This mixture has a melting point below that of either of the components and is liquid at room temperature.

CATALYST PREPARATION, ACTIVATION, AND REGENERATION

U.S.P. 2,475,650. Multistage Process of Regenerating a Fluidized Catalyst. W. I. Thompson and C. W. Tyson to Standard Oil Development Company.

Finely divided spent contact material is continuously regenerated in two phases. In the first phase a suspension of the material in an oxygen-containing regenerating gas stream is partially regenerated and then separated from the gas. In the second phase it is further regenerated by regenerating gas with a higher inlet oxygen concentration than employed in the first zone. Fresh spent contact material is treated simultaneously with gas of the relatively low oxygen concentration in the first regenerating zone.

U.S.P. 2,475,984. Process for Drying Hydrogel Catalysts. J. J. Owen to Standard Oil Development Company.

Inorganic hydrogel spheres are introduced into the upper portion of a drying zone against a rising stream of hot inert gas. The velocity of this gas stream is regulated to permit the spheres to settle slowly to the lower portion of the zone as a dense phase fluidized mass having a level. The hot gas is introduced at points above and below this level. Dry gel spheres are obtained for use as hydrocarbon conversion catalysts.

U.S.P. 2,476,920. Catalyst for Reduction of Oxides of Carbon with Hydrogen. M. A. Segura to Standard Oil Development Company.

A catalyst for the Fischer-Tropsch synthesis is obtained by roasting and sintering an iron pyrite ore, withdrawing sulfur dioxide grinding the sintered ash to powder, and adding 0.5-10 percent of an alkali metal compound as a promoter. The composite is reduced with hydrogen at a temperature of 550-1100° F.

U.S.P. 2,477,019. Method for Heat-Treating Solid Inorganic Adsorbents. E. Utterback and E. V. Bergstrom to Socony-Vacuum Oil Company, Inc.

Details of a method are claimed for heat treating particle form solid adsorbent materials of the type used for adsorption, catalytic conversion, and the like. The solid material is passed as a compact column downwardly through a vessel while introducing cold gas near the lower end of this column. The solid material heated within the upper part of this vessel to the desired treating temperature is thus cooled before leaving the vessel.

U.S.P. 2,477,038. Hydrogen Fluoride Sludge Decomposition Process. H. S. Bloch to Universal Oil Products Company.

A hydrocarbon-HF-complex or sludge, as obtained by contacting anhydrous HF with hydrocarbons, is decomposed by passing it at decomposition temperature and pressure over a metallic catalyst comprising Sn, Pb, Al, Cr, Zn, Ni, Fe, Ag, Sb, Co, Cu, Mg, Bi, W, or Cd, or mixtures of such metals. The resultant products are separated into an overhead vaporous fraction comprising the HF and a liquid bottom fraction comprising the hydrocarbon product containing polyenic hydrocarbons with conjugated and non-conjugated unsaturation.

U.S.P. 2,477,345. Process and Apparatus for the Regeneration of Hydrocarbon Conversion Catalyst. H. L. Pelzer to Sinclair Refining Company.

In the regeneration of a hydrocarbon conversion catalyst, the spent catalyst is passed progressively through an outer annular zone, an intermediate annular zone, and an inner cylindrical zone. All these co-axial zones are in open communication at their upper ends. Details are claimed for the treatment of the catalyst in these zones to effect complete regeneration of the catalyst in a dense phase fluidized body.

U.S.P. 2,477,373. Catalyst Preparation. J. B. Hunter to The Atlantic Refining Company.

An acid-stabilized silica sol with a pH of 1-3 is mixed with an acid adsorptive aluminum having an acid adsorptive value of at least 300 and a stability of at least 200 in an amount sufficient to raise the pH of the mixture above 3 by adsorption of acid from the silica sol. Silica-alumina gel formation occurs by means of this pH increase. The acid adsorptive alumina is prepared by reacting alumina sulfate with an alkali metal bicarbonate. The silica-alumina catalyst thus produced has improved stability and is useful in the conversion; e.g., cracking of hydrocarbons.

U.S.P. 2,477,386. Method of Improving the Adsorbent and Decolorizing Properties of Georgia-Florida Fuller's Earth. W. S. W. McCarter to Attapulgus Clay Company.

Georgia-Florida type fuller's earth is mixed with 0.1-1.75 percent of a water-soluble alkaline reagent and sufficient water to give a plastic earth containing 45-60 percent water. This plastic earth is treated with enough mineral acid to just neutralize the alkaline reagent and is then extruded under elevated pressure and dried. The decolorizing effi-

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ciency of the fuller's earth is improved by this neutralizing acid treatment.

U.S.P. 2,477,638. Silica-Zirconia Catalysts and Preparation Thereof. T. H. Milliken, Jr., and G. A. Mills to Houdry Process Corporation.

Dried pellets produced from fully aged silica-zirconia hydrogel are treated with mineral acid of 3-15 percent concentration for at least one hour, then washed and dried. The resulting pellets of a bulk density not greater than 0.61 show improved selectivity and give superior gasoline to coke ratios in hydrocarbon cracking operations.

U.S.P. 2,477,639. Process of Activating Kaolin Clay. G. A. Mills to Houdry Process Corporation.

Calcined kaolin clay is treated with water for at least 15 minutes at a temperature in the range of 250° F. and below the critical temperature of water and under a pressure at least sufficient to maintain the water in liquid phase. Subsequently the clay is acid leached. The resulting catalyst has improved steam stability.

U.S.P. 2,477,664. Process of Acid-Activating Kaolin Clay. H. A. Shabaker to Houdry Process Corporation.

The process of this patent is closely related to that of U.S.P. 2,477,639. It differs essentially only in that the step of acid leaching the water treated kaolin clay is omitted.

U.S.P. 2,477,695. Treating Hydrosols with Fluorides to Obtain Improved Gel Catalysts. C. N. Kimberlin, Jr., to Standard Oil Development Company.

A silica hydrosol is treated with hydrogen fluoride or an alkali metal fluoride in an amount equivalent to at most 4 molecules of HF per molecule of silicon dioxide. The pore diameter of the resultant gel is substantially increased by this treatment and its particle density is reduced.

U.S.P. 2,478,194. Catalyst Pellet. E. J. Houdry to Houdry Process Corporation.

A unitary catayst pellet is described which is effective in contacting operations and consists of two interlocking solid bodies of complementary shape. Each of these bodies co-acts with the other in the interior of the pellet to fix its position therein, and each body presents separate and contiguous portions of the exterior surface of the pellet. One of the bodies is of adsorptive or catalytically active material and occupies at least 40 percent of the total pellet volume, while the other body is of catalytically inert oxide of higher heat capacity than the first named material (at least 425 g.-calories per degree C.) and occupies at least 25 percent of the pellet volume.

U.S.P. 2,478,519. Process of Manufacturing Silica-Base Gel Catalysts which Includes Aging. K. D. Ashley and A. O. Jaeger to American Cyanamid Company.

Details of a process are claimed for preparing a silica-containing catalyst. In this process an aqueous slurry of gelatinous silica containing water-soluble inorganic salts is aged.

Patents

CRACKING AND REFORMING

U.S.P. 2,476,729. Catalytic Cracking with Air. C. J. Helmers to Phillips Petroleum Company.

A hydrocarbon oil which contains constituents capable of forming coke on complete vaporization is preheated to a temperature such that only the non-coke forming constituents are vaporized. All of the preheated oil is then mixed with an oxygen-containing gas. The resultant mixture is contacted with a bed of inert, non-catalytic, granular heat resistant material, and the hydrocarbon oil is subjected therein to partial combustion to elevate the temperature to a point sufficient to effect complete vaporization of the hydrocarbon oil including the coke-forming constituents. The vaporized mixture is contacted with a contiguous bed of cracking catalyst under conditions to crack the hydrocarbons.

ALKYLATION

U.S.P. 2,476,750. Process for Producing Motor Fuel by Alkylation. M. P. Matuszak to Phillips Petroleum Company.

An alkylatable paraffin and an olefin are alkylated in the presence of a suitable catalyst. The effluent mixture is further alkylated with an alkylatable cyclic organic compound in a second alkylating zone and the effluent mixture from this zone is further alkylated with an olefin in a third alkylation zone. A hydrocarbon fraction boiling within the motor fuel boiling range is removed from the resulting effluent as a product of the process.

ISOMERIZATION

U.S.P. 2,476,416. Isomerization of Paraffin Hydrocarbons by Contact with Catalyst Comprising Aluminum Chloride and Ferric Chloride. V. N. Ipatieff and H. Pines to Universal Oil Products Company.

A normal paraffin is contacted with a mixture of aluminum chloride and ferric chloride containing at least 20 molecular percentage of the latter at a suitable temperature to effect isomerization.

POLYMERIZATION AND CONVERSION

U.S.P. 2,475,628. Ethylene Polymerization Process. E. E. McSweeney to Standard Oil Company of Indiana.

A gas stream comprising ethylene and a peroxide catalyst is continuously treated under suitable polymerization conditions to form a normally solid polymer. A moving liquid film consisting of an aqueous solution of a surface active substance, such as alkyl aromatic sulfonate, is maintained on the confining interior surfaces of the polymerization zone only without substantial agitation of the gas and this solution. The polymer is obtained as a suspension in the solu-

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Patents

tion while adherence of polymer formed to the reactor walls is prevented by said film. A di-peroxydicarbonate ester is preferred as the catalyst.

U.S.P. 2,475,643. Ethylene Polymerization Process. J. E. Seebold to Standard Oil Company of Indiana.

The process of this patent is closely related to that of U.S.P. 2,475,628. In the present case the moving film consists of water only. The catalyst employed has the general formula

$$R_1O-\overset{\overset{O}{\|}}{C}-O-O-\overset{\overset{O}{\|}}{C}-OR_2$$ wherein R_1 and R_2 are alkyl radicals. The polymerization temperature can be 0-100° C. and the pressure 1400-10,000 psi.

U.S.P. 2,475,648. Polymerization of Ethylene by Diperoxy-Dicarbonate Ester Catalysts. G. G. Stoner and R. L. Savage to Standard Oil Company of Indiana.

The process of this patent is related to U.S.P. 2,475,628 and 2,475,643. The use of a di-peroxydicarbonate ester in the polymerization of ethylene is claimed here independently of the use of a moving film on the walls of the reaction zone. An amount of 0.01-10 percent of the catalyst and a pressure of 500-10,000 psi. are employed in the reaction.

U.S.P. 2,475,822. Catalytic Reaction Apparatus. L. W. T. Cummings to Sun Oil Company.

Details of an apparatus are claimed for conducting alternate endothermic and exothermic catalytic conversion reactions.

U.S.P. 2,475,855. Catalytic Reaction Apparatus. H. F. Peters to Sun Oil Company.

The apparatus according to this patent is related to that of U.S.P. 2,475,822 and serves the same purpose.

U.S.P. 2,476,064. Hydrocarbon Polymerization Products and Process of Making and Using the Same. B. L. Ritz and H. L. Johnson to Sun Oil Company.

A mixture of 15-80 parts of non-conjugated aliphatic isoolefin of 4-6 C atoms with a double bond in the alpha position and a hydrocarbon group in the beta position, 10-50 parts of an aliphatic 1,3-conjugated diolefin, 5-50 parts of a vinyl substituted aryl compound, and at least 10 parts of an aliphatic monoolefin containing only olefinic unsaturation of 3-5 C atoms, other than the isoolefin are copolymerized at temperatures below 0° C. in the presence of a Friedel-Crafts catalyst under particular conditions. A polymer with inherent tackifier properties is formed.

U.S.P. 2,476,143-4. Pyrolytic Conversion of Hydrocarbons with the Aid of a Fluidized Catalyst. W. S. Gullette to Sinclair Refining Company.

In the vapor phase conversion of hydrocarbons by means of a dense phase fluidized body of solid catalyst which is regenerated in the fluidized dense phase state, catalyst is uniformly withdrawn from throughout the height of one of the two relatively dense phase fluidized bodies of catalyst and returned to the

other body of catalyst. Uniformity of circulation of the catalyst through the system is thus effected. Thus, catalyst is withdrawn for regeneration from throughout the height of the catalyst in the reaction zone.

U.S.P. 2,477,018. Synthetic Rubbery Copolymers of Normal Olefins with Diolefins. R. M. Thomas and H. C. Reynolds to Standard Oil Development Company.

A major proportion of a normal olefin with 3-6 C atoms is copolymerized with a minor proportion of a polyolefin with 4-10 C atoms by means of predetermined amounts of a solution of a Friedel-Crafts catalyst in an alkyl halide with less than 4 C atoms at a temperature below —10° C. A rubbery product is obtained.

U.S.P. 2,477,042. Method of Heat Exchange in Fluidized Hydrocarbon Conversion Systems. H. E. W. Burnside to Standard Oil Development Company.

Details of a method are claimed for converting gaseous fluid hydrocarbons mixed with powdered catalyst to a relatively dense dry fluidized mixture, and for regenerating the spent catalyst. Heat is removed from the spent catalyst by indirect heat exchange with control of the rate of heat transfer.

U.S.P. 2,477,281. Method for Hydrocarbon Conversion. E. V. Bergstrom to Socony-Vacuum Oil Company, Inc.

Details of a cyclic process for the conversion of hydrocarbons are claimed wherein a particle-form solid contact material is moved cyclically as a compact column through a conversion zone and then through a regeneration zone. The invention relates specifically to a method for achieving uniform size distribution of contact material particles in the moving columns.

U.S.P. 2,477,290. Catalyst Complexes for Alkylation Processes. R. W. Dornte and D. W. Young to Standard Oil Development Company.

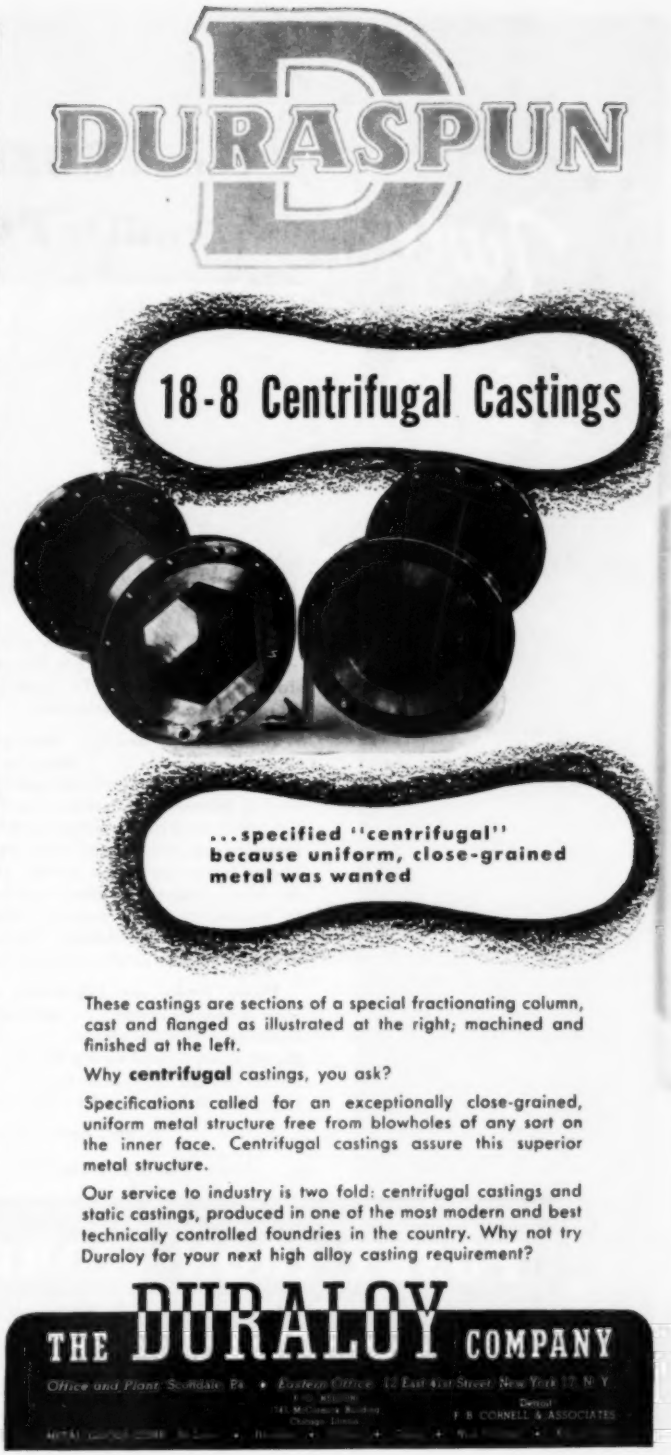
Hydrocarbons are converted by contacting them with a catalyst comprising a complex of a Friedel-Crafts catalyst with a chlorinated ether. Alkylation separately or in combination with polymerization can, for example, be effected by this method. High anti-knock fuels can be obtained by reacting olefins with an isoparaffin in this manner.

U.S.P. 2,477,338. Promotion of Conjugated Diene Emulsion Polymerization by Trichloromethyl - Substituted Mercaptans. J. E. Kirby and W. H. Sharkey to E. I. du Pont de Nemours & Company.

Butadiene-1,3 hydrocarbons and their 2-monohalogen derivatives are emulsion polymerized in the presence of 0.2-10 percent of an aliphatic or cycloaliphatic monothiol with 2-9 C atoms and a trichloromethyl group, such as 5,5,5-trichloropentanethiol.

U.S.P. 2,477,382. Aryl Substituted Alkanes and Process of Making the Same. A. H. Lewis to California Research Corporation.

An aromatic hydrocarbon of the benzene series is condensed with propylene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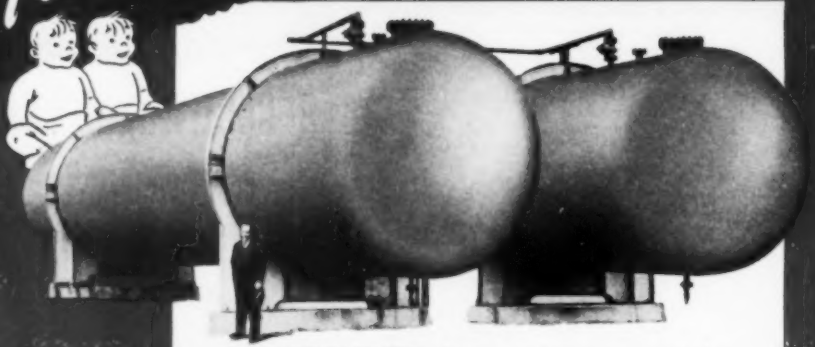

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polymers having about 12-15 C atoms and boiling between 340-520° F. in the presence of a catalyst, such as hydrogen fluoride. Monoaryl-substituted C_{12}-C_{18} alkanes are recovered from the reaction mixture by distillation. These alkanes are convertible to sulfonic acids without material decomposition of the alkyl chain.

U.S.P. 2,477,502. Method for Conducting Gaseous Reactions in the Presence of a Moving Particle Form Solid. E. Utterback and E. V. Bergstrom to Socony-Vacuum Oil Company, Inc.

Endothermic hydrocarbon gas conversions, such as the conversion of saturated hydrocarbons to ethylene, or the conversion of n-butane to butadiene and thiophene, by means of a moving column of particle form solid, are carried out by supplying solid to the upper end of the column at a temperature substantially below the reaction temperature, maintaining it at reaction temperature in an intermediate portion of the column, and cooling it below this temperature by the gaseous reactants introduced into the lower section of the column at a temperature substantially below the reaction temperature. The cooled solid withdrawn is recycled to the upper end of the column. The solid is heated to reaction temperature in the upper portion of the column before its entry into the intermediate portion of the column by the gaseous reaction products formed in this portion while these products are quenched to a lower temperature and then withdrawn from the upper portion of the column. Any net heat loss from the intermediate portion of the column is balanced by introducing a controlled amount of a heat exchange gas at a temperature above the reaction temperature at the level where cooling effect of the reactant gas on the solid becomes negligible.

U.S.P. 2,477,538. Production of Polymeric Oil. D. E. Badertscher and R. B. Bishop to Socony-Vacuum Oil Company, Inc.

An aromatic-rich hydrocarbon fraction with a boiling range of about 300-750° F. obtained by cracking petroleum stock is reacted with 6-27 percent by weight of formaldehyde in the presence of 3-15 percent hydrogen fluoride. The reaction time shall not be greater than two hours for temperatures of —5° C. to 100° C. and not greater than two minutes for temperatures of 400-1000° C. The cooled reaction mixture is neutralized and polymeric oil is recovered from the liquid hydrocarbons separated from the reaction mixture.

U.S.P. 2,477,750. Conversion of Hydrocarbons with Suspended Catalyst. E. A. Johnson to Standard Oil Company of Indiana.

A spent dense suspension of catalyst is passed from a low point of a hydrocarbon conversion zone directly and without change of pressure to a low point in an adjacent regeneration zone where the catalyst is maintained in dense suspension and contacted with oxygenous gas. Dense catalyst suspension from a high point in the regeneration zone is returned directly to a low point in the conversion zone in a moving fluid stream

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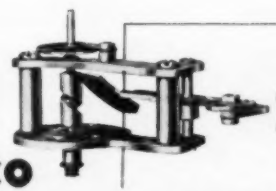

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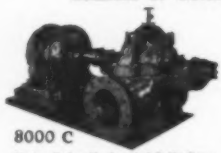
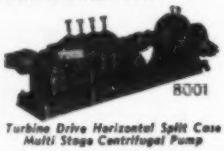


8000 C

Motor Drive Horizontal Split Case Double Suction Centrifugal Pump

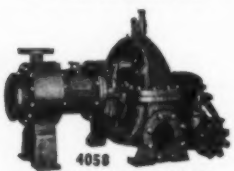


8001

Turbine Drive Horizontal Split Case Multi Stage Centrifugal Pump

4049 A

Two Stage Close Coupled Centrifugal Pump



4058

Turbine Drive Close Coupled Centrifugal Pump

942

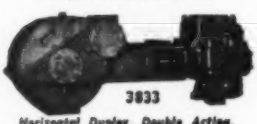
Single Style, Packed Piston Pattern Steam Pump

2352 B

Durable Duplex, Outside End Packed, Plunger Pattern Steam Pump

3918

Durable Duplex, Packed Piston Pattern Steam Pump



3833

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Patents

under pseudo hydrostatic pressure. Circulation of catalyst suspension between both zones is maintained through unimpeded passages solely by the pseudo hydrostatic pressure of the dense suspension in one of these zones.

U.S.P. 2,477,751. Apparatus for Suspended Catalyst Operations. E. A. Johnson to Standard Oil Company of Indiana.

The apparatus according to this patent is suitable for carrying out the process according to U.S.P. 2,477,750. It minimizes the power requirements for the recycling of catalyst between the two zones.

U.S.P. 2,478,066. Polymerization of Olefins in the Presence of Nitrogen Compounds. A. J. van Peski to Shell Development Company.

Olefin is polymerized by heating to a temperature of at least 100° C. in the presence of an acidic organic nitrogen compound which derives its acidic properties solely from the nitrogen-containing group of the molecule and which decomposes under the reaction conditions. Examples of such compounds are nitro-hydrocarbons and compounds having a trivalent nitrogen atom linked by a double bond to a single carbon atom of a divalent organic radical.

U.S.P. 2,478,707. Catalytic Reactor. R. L. Purvin to Standard Oil Development Company.

A catalyst nozzle is described for use in polymerization reactions involving a liquid-reactant and a liquid catalyst, e.g. for the copolymerization of isobutylene and isoprene in the presence of aluminum chloride. Means are provided for shutting off the opening at the inner end of the nozzle when the pressure of the reaction mixture equals that at which the catalyst is being injected.

HYDROGENATION, DEHYDRATION, AROMATIZATION

U.S.P. 2,475,718. Process for the Hydrogenation of Naphthalene Compounds. D. Papa and E. Schwenk to Schering Corporation.

Naphthalene compounds and alkyl naphthalenes, such as beta-methyl-naphthalene, are reacted with an aqueous alkali solution in the presence of an alloy of a metal capable of reacting with this solution to yield hydrogen, and a catalytic metal relatively inert toward the alkali solution, e.g. a Raney nickel-aluminum alloy.

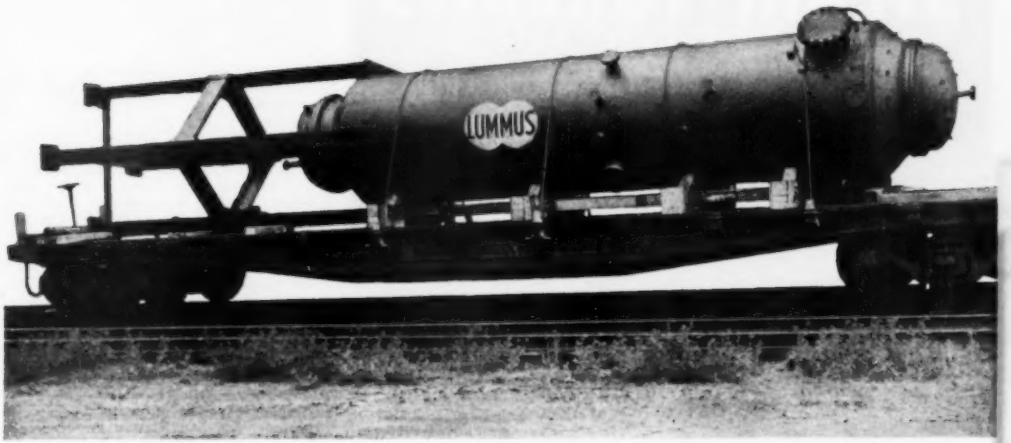
U.S.P. 2,475,977. Production of Polycyclic Aromatics. H. H. Meier to Standard Oil Development Company.

A petroleum naphtha feed stock boiling between 350-390° F. and containing substantial amounts of the naphthenic derivatives of naphthalene is segregated and contacted with a hydroforming catalyst at a temperature above 850° F. and at a pressure of 0-500 psi. in the presence of added hydrogen. A substantial portion of the naphthenic naphthalene derivatives is converted to naphthalene.

U.S.P. 2,475,993. Catalytic Conversion

SEPARATES WAX FROM SOLVENTS

in one stage



A soft wax solvent mix is processed in this vertical evaporator, designed and built by Lummus for an MEK dewaxing unit of a well known refinery. With 10 psig exhaust steam as the heating medium, approximately 85% of the solvents is flashed off.

The efficiency of this unit was made possible by bold departure from customary design. Over the top of the heating element, which extends about ⅔ of the way up the shell interior, a dished and flanged disc deflector directs outward and downward the mixture of vapor and liquid ascending from the tubes. Above the disc deflector, a ring-shaped baffle, through which the vapor passes, is attached to the vapor body shell. Among the ingenious details of the design is a special internal expansion joint comprised of flanged and flued rings.

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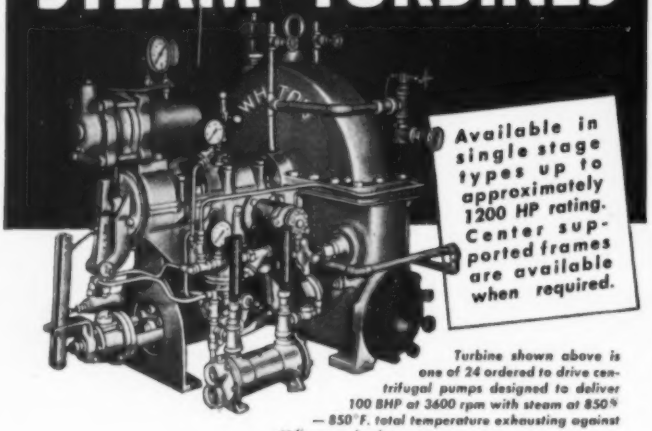

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Patents

Process. W. D. Seyfried to Standard Oil Development Company.

A mixture of butylenes is heated to 1100-1300° F. and a diluent for the reaction (e.g. steam) heated to the same temperature range is contacted with a bed of solid absorbent material to remove iron, its compounds, and other foreign materials therefrom. The diluent is then mixed with the hot butylenes, and this mixture is passed through a bed of a dehydrogenation catalyst. Eutadiene is recovered.

U.S.P. 2,476,788. Method for the Recovery of Hydrocarbon Synthesis Products. P. C. White to Standard Oil Company of Indiana.

The vaporous reaction product from the hydrogenation of carbon monoxide in the presence of an alkali-promoted iron catalyst is cooled and a two-phase liquid fraction is condensed therefrom at a temperature above 185° F. The condensate is stratified and an aqueous phase containing not more than a minor proportion of organic oxygenated compounds is withdrawn from the condensate at a temperature above 185° F.

U.S.P. 2,477,740. Hydrocarbon Dehydrogenation Process Using Hydrogen as a Process Gas and Carbon Dioxide as a Stripping Medium. H. W. Grote to Universal Oil Products Company.

Spent catalyst employed in the continuous dehydrogenation of hydrocarbons in the presence of free hydrogen is continuously separated from the conversion products and stripped with carbon dioxide. The resulting mixture of CO_2 and hydrocarbons desorbed from the catalyst is commingled with the conversion products. A fraction containing the bulk of hydrogen and CO_2 is separated and subjected at least in part to the action of a reagent containing an organic nitrogenous base reactive with CO_2. Hydrogen and CO_2 are recovered separately and recycled.

U.S.P. 2,478,205. Synthesis of Perylene. M. Orchin to the U. S. Secretary of the Interior.

1,1'-dinaphthyl is catalytically dehydrogenated in the vapor phase on a bed of paladium-carbon at temperatures of about 500° C.

HEAVY OILS AND WAXES

U.S.P. 2,475,589. Lubricating Grease Composition. A. A. Bondi to Shell Development Company.

A mechanically stable, thermally reversible lubricating grease comprises a major amount of lubricating mineral oil and 5-25 percent of a soap derived from a mixture of 10-90 percent of a hydroxy fatty acid and 90-10 percent of a hydrogenated fatty acid, each of at least 6 C atoms.

U.S.P. 2,475,727. Lubricating Oil Compositions and Improvement Agents Therefor. H. G. Smith and T. L. Cantrell to Gulf Oil Corporation.

A mineral lubricating oil contains a small percentage of an anhydrous non-hygroscopic mixture of sperm oil alcohols and the calcium-salts of sperm oil

0 TO 10 PSI
30 TO 10,000 PSI
0 TO 30 PSI (ABSOLUTE)
Here's where to start
14 TO 4,000 PSI
10 TO 17 PSI
5 TO 30 PSI
FURNACE PRESSURE DRAFT

FOR PRECISE PRESSURE CONTROL

These measuring elements are the heart of Brown pressure control systems for the Petroleum Industry . . . because precision control starts with precise measurement!

Complete coverage of pressure problems necessitates this complete line of elements. There's a specific one for each application . . . from microns to tons . . . from corrosive to non-corrosive! They make Brown Pressure Gauges *the finest available to the Petroleum Industry!*

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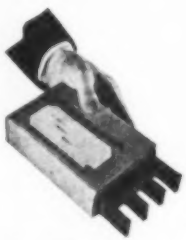
Honeywell *Advanced Instrumentation* FOR THE PETROLEUM INDUSTRY BROWN INSTRUMENTS

WHICH ADVANTAGE

is most important to you when specifying grating?



1 Rigid one-piece construction—easy to install?

2 Maximum open area for light and air?

3 Easy to paint—all surfaces accessible?

4 Non-slip Twisted Cross-Bar?

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WRITE TODAY . . .

For this "paper-weight-size sample" on your business letterhead, so that you can have a "close-up" of Blaw-Knox Grating Construction.

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Patents

fatty acids in substantially the same proportions in which these alcohols and acids exist in unsaponified sperm oil. The lubricant has improved detergent, anti-oxidant and oiliness properties.

U.S.P. 2,475,970. Lubricants. E. Lieber and R. M. Dean to Standard Oil Development Company.

A waxy mineral lubricating oil contains dissolved a pour depressing amount of a Friedel-Crafts condensation product of diisobutylene with another initial Friedel-Crafts condensate of particular composition.

U.S.P. 2,476,271. Lubricating Oil Additive. J. D. Bartleson to The Standard Oil Company of Ohio.

A mineral lubricating oil contains a small amount of an amine of the formula $R—N\begin{matrix}/R_1\\ \backslash R_2\end{matrix}$ wherein R is an aliphatic hydrocarbon radical of 10-24 C atoms, having one double bond, and R_1 and R_2 are alkyl radicals with 1-5 C atoms. The additive inhibits oxidation of the oil.

U.S.P. 2,476,696. Mineral Oil Composition. S. Caplan and P. L. Rosamilia to The Harvel Corporation.

Sludging of mineral hydrocarbon oil with a flash point above 250° F. is inhibited by compounding it with a small amount of a hydrocarbon ether of hydrogenated cardanol.

U.S.P. 2,476,812-3. Lubricating Composition. J. P. Buckmann and L. L. Neff to Union Oil Company of California.

A mineral lubricating oil is compounded with a small amount of an oil-soluble metal salt (e.g. an alkaline earth metal salt) of the reaction product obtained by phosphosulfurizing a hydrocarbon lubricating oil fraction from which the most highly aromatic and the most highly paraffinic components have been removed. This oil fraction is obtained by one of several different methods described in detail.

U.S.P. 2,476,955. Production of Drying Oils. H. S. Bloch to Universal Oil Products Company.

A hydrocarbon mixture containing polyolefinic polycyclic hydrocarbons, the unsaturated bonds of which are non-aromatic and in conjugated as well as non-conjugated relation to each other, is produced by contacting an olefinic codimer gasoline fraction boiling at about 30-250° C. with a hydrogen fluoride catalyst containing not more than 10 percent water under reaction conditions to form a HF-sludge containing a hydrocarbon-HF addition complex. This sludge is passed under suitable conditions over a decomposition catalyst to form a HF-vapor phase and a liquid hydrocarbon phase which is recovered. The hydrocarbon mixture obtained is particularly suitable for use as a drying oil.

U.S.P. 2,476,972. Mineral Oil Composition. E. W. Fuller and E. M. Johnson to Socony-Vacuum Oil Company, Inc.

A viscous mineral oil fraction contains admixture of 0.5-5.0 percent of an oil-soluble magnesium sulphonate and of 0.1-3.0 percent of an oil-soluble phos-

phorous and sulfur containing reaction product from one molecule of a phosphorus sulfide and 4 molecules of a dicyclic terpene or an essential oil containing it. The additives improve the corrosion and oxidation characteristics of the oil.

U.S.P. 2,477,244. Stabilized Organic Sulfur-containing Composition and Method of Preparing Same. J. W. Gaynor to Standard Oil Company of Indiana.

A major proportion of a hydrocarbon oil is compounded with an organic sulfur-containing compound which normally evolves hydrogen sulfide, and with 0.001-25 percent by weight (based upon the sulfur-containing compound) of an alpha-beta unsaturated aliphatic ketone. While the sulfurized materials impart anti-corrosion and extreme pressure properties, etc., to lubricating oils, the ketone additive inhibits H_2S evolution from these materials.

U.S.P. 2,477,296. Lithium-Aluminum Soap Lubricating Grease and the Method of Making the Same. C. W. Georgi to Enterprise Oil Company, Inc.

Details are claimed for a compound of lubricating oil with a Li-Al-soap of certain saturated higher fatty acids.

U.S.P. 2,477,311. Lubricaing Grease Compositions. A. J. Morway to Standard Oil Development Company.

A lubricating grease comprises a major proportion of lubricating oil, 2-20 percent acetylene carbon black or channel black, 1-30 percent petroleum resin of special derivation, and 0.1-5 percent sulfur.

U.S.P. 2,477,356. Turbine-Oil. S. J. Wayo to Sinclair Refining Company.

A lubricating composition useful as a turbine oil comprises a petroleum oil with which is compounded an alkylmercaptoacetic acid and a smaller amount of an alkylsulfinylacetic acid. The alkyl group of each of these acids shall contain at least 12 C atoms. Their amount shall not be more than 1 percent on the weight of the oil, but sufficient to impart corrosion-inhibiting property to the composition.

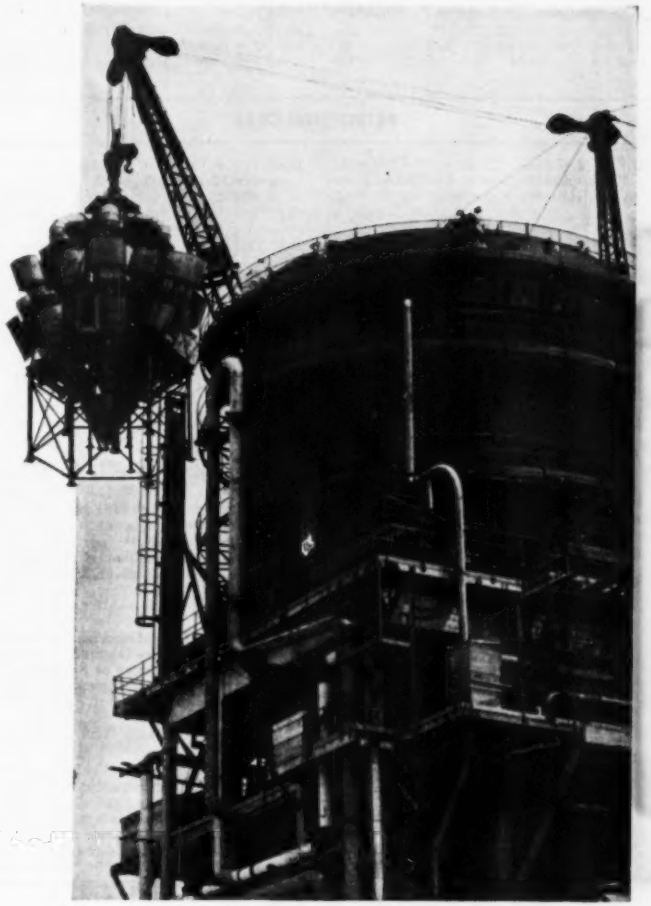
U.S.P. 2,477,913. Mineral Lubricating Oil. M. van Loon to Shell Development Company.

Mineral lubricating oil contains .1-1 percent of an oil-soluble composition produced by heating the zinc salt of diisopropyl salicylic acid in the presence of a stable hydrocarbon oil to a temperature of 300° C. for ¾ to 1½ hours, whereby the precipitate formed is redissolved in the stable oil. The additive provides excellent antioxidant and detergent properties to the lubricant.

U.S.P. 2,478,694. Lubricant. H. D. Hineline and D. W. Young to Standard Oil Development Company.

A multiolefin with 4-14 C atoms is polymerized to a molecular weight of 3000 to several hundred thousand. The resulting polymer is cyclicized. The resulting product is chemically combined with a phosphorus halide. 0.5-20 percent of the compound thus obtained is dissolved in a mineral lubricating oil to

BUELL 'GOES TO THE TOP'
in catalyst recovery



In fluid or thermofor catalytic cracking Buell recovery systems have demonstrated continuous high-efficiency performance in all the major refineries. Design information is available on the latest multi-stage collectors. Buell Engineering Company, 70 Pine Street, Suite 5070, New York 5, N. Y.

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DUST COLLECTION

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Patents

form a high-viscosity lubricant with extreme pressure properties.

U.S.P. 2,478,843. Mineral Oil Composition. R. B. Seymour and F. L. Matthews to Monsanto Chemical Company.

A lubricating mineral oil contains a viscosity-increasing amount of an oil-soluble polymerization product of arcyclohexylstyrene. This additive keeps wax contained in the mineral oil from crystallizing.

U.S.P. Re. 23,140. Synthetic Lubricant. O. M. Reiff, H. D. Hartough, and H. J. Andress, Jr. to Socony-Vacuum Oil Company, Inc.

A lubricant with a pour point of 0° F. or less is produced by halogenating a crystalline paraffin wax and further treating the mixture of halogenated and unhalogenated wax formed with xylene in the presence of a Friedel-Crafts catalyst. A small amount of an ester of an alkyl-substituted phenol is finally added.

PETROCHEMICALS

U.S.P. 2,475,605. Process of Producing Predominantly Lower Oxidation Products from Hydrocarbons. C. F. Prutton, C. O. Miller, and W. C. Craig to The Lubrizol Corporation.

Hydrocarbon rich in unsaturates is subjected in the liquid phase to the action of a gas containing free oxygen at an average rate of .0038-.0825 mole of oxygen per minute per mole of hydrocarbon for a period of not more than 15 minutes. The heat of reaction is largely removed simultaneously so that the temperature of the liquid is maintained at 140-170° C.

U.S.P. 2,475,731. Copolymerization Products of Styrene and Adduct Modified Glycol-Maleate Resins. G. S. Weith to Bakelite Corporation.

Styrene is copolymerized with a fusible resin obtained by the esterification of a mixture of maleic anhydride and cyclopentadiene maleic adduct with a glycol. Hardenable resins are obtained.

U.S.P. 2,476,027. Copolymers of Butadiene and Tetrahydrofurfuryl Methacrylate. A. M. Clifford to Wingfoot Corporation.

An aqueous emulsion of 50-80 parts butadiene-1,3, 50-20 parts tetrahydrofurfuryl methacrylate and a polymerization catalyst is copolymerized at a temperature of 30-80° C. The resulting latex is coagulated.

U.S.P. 2,476,771. Production of Vinyl Cyanide. P. L. Salzberg to E. I. du Pont de Nemours & Company.

In the preparation of vinyl cyanide by reacting acetylene and HCN in an aqueous acidic solution of Cu_2Cl_2 containing a salt of ammonium, amine, or alkali metal, arsenic or bismuth are also contained in this solution.

U.S.P. 2,477,380. Production of Tertiary Aliphatic Alcohols. S. I. Kreps and F. C. Nachod to The Atlantic Refining Company.

An iso-olefin and water are contacted with an organic hydrogen ion exchange hydration catalyst, such as a sulfonated resin, under hydrating conditions of temperature and pressure (e.g. at 150-300° F. and 50-500 psi.). Tertiary alcohol formed is separated from unconverted reactants. Tert. butyl alcohol is, for example, formed from isobutylene.

U.S.P. 2,477,435. Oxidation of Ethylene to Ethylene Oxide and Other Olefins to Their Oxides. R. S. Aries, Short Beach, Conn.

A mixture of an olefin in the gaseous state and free oxygen containing gas is passed over a solid porous catalyst at a temperature of 200-300° C. The amount of olefin shall be less than required for the complete formation of the olefin oxide by the oxygen present. The catalyst employed is prepared by impregnating a porous carrier with an aqueous solution of a silver salt of an organic acid at a temperature of 100-125° C. in the presence of an oxidizing agent, the decomposition products of which are volatile below 300° C., e.g. H_2O_2. The impregnated carrier is heated after removal of surplus liquid and drying to 300-500° C. in the presence of an inert gas to decompose the deposited silver salt. Ethylene oxide is thus produced from ethylene.

U.S.P. 2,478,243. Process of Nitrating Olefins. C. S. Coe and T. F. Doumani to Union Oil Company of California.

For the preparation of mononitroolefins, HNO_3 of 90-100 percent concentration is slowly added to at least an equimolal quantity of an olefin boiling below 200° F. The mixture is maintained at a temperature of —40° to +10° C.

U.S.P. 2,478,390. Polymerization of Polymerizable Mono-Olefinic Hydrocarbons in the Presence of Saturated Aliphatic Esters of Inorganic Oxy Acids of Phosphorus, Sulfur, and Silicon. W. E. Hanford and R. M. Joice, Jr., to E. I. du Pont de Nemours & Company.

A mixture of a plurality of molecules of a monoolefinic aliphatic hydrocarbon with 2-4 C atoms and the components of one molecule of a saturated aliphatic ester of an inorganic oxy acid containing only hydrogen, oxygen, and an element of the atomic number 14-16 is subjected at increased pressure and a temperature of 60-150° C. to the action of a free radical type polymerization initiator, e.g. a peroxy catalyst. The resulting products contain polymerization products of the hydrocarbon and fragments of the ester employed.

U.S.P. 2,478,464. Production of Aromatic Nitriles. W. I. Denton and R. B. Bishop to Socony-Vacuum Oil Company, Inc.

An aromatic hydrocarbon with 7-11 C atoms and having at least one nuclear hydrogen replaced by a univalent, aliphatic, non-acetylenic hydrocarbon radical is contacted with gaseous ammonia at temperatures between 850-1250° F. in the presence of a nickel or cobalt salt stable under the reaction conditions. Aromatic nitriles are obtained.

U.S.P. 2,478,484. Preparation of Acyl Thiophenes. H. D. Hartough and A. I. Kosak to Socony-Vacuum Oil Company, Inc.

An acylatable thiophene is reacted with an aliphatic carboxylic acid (e.g. oleic acid) in the presence of P_2O_5. Compounds are formed which have an acyl radical attached to the thiophene nucleus.

U.S.P. 2,478,737. Preparation of 2-Chloro-1,3 Butadiene Co-polymers Having Improved Stability. R. S. Barrows to E. I. du Pont de Nemours & Company.

A rubber-like co-polymer is formed from 60-5 percent of a 1,3-diene hydrocarbon and 40-95 percent of 2-chloro-1,3-butadiene and then incorporated with a relatively small amount of a tetra-alkyl-p,p'-diamino-diphenyl compound, or the like, for stabilization.

U.S.P. 2,478,738. Polymerization of Chloroprene in the Presence of Tetra-alkyl-diamino-diphenyl Methane. R. S. Barrows to E. I. du Pont de Nemours & Company.

In the process according to U. S. patent 2,478,737 tetra-alkyl-p,p'-diamino-diphenyl methane, particularly, is employed as the stabilizing additive.

U.S.P. 2,478,776. Catalytic Oxidation of Hydrocarbons. M. E. Nash to Phillips Petroleum Company.

An open-chain hydrocarbon containing at least two adjacent tert. C atoms is contacted in the liquid phase with an oxygen-containing gas in the presence of nitrobenzene at a temperature of 0-300° C. Unsaturated aliphatic aldehydes are produced.

DESULFURIZATION

U.S.P. 2,478,603. Removal of Sulfur. C. A. Stratton to Phillips Petroleum Company.

A relatively light or gaseous hydrocarbon mixture containing sulfur compounds is successively contacted with at least two concentrated caustic solutions of progressively increasing alkalinity. Thereafter, the hydrocarbon stream is contacted with a caustic solution containing litharge. Desulfurized hydrocarbons and precipitated lead mercaptides are separated in this final contact zone. Caustic solutions from each zone are transferred to the next preceding zone upon substantial depletion of litharge in the final zone. Spent caustic is removed from the first zone.

Oil Shale Meet Scheduled

The Institute of Petroleum's second conference on oil shale and cannel coal will meet in Glasgow, Scotland, during the week commencing July 3, 1950, in observance of the centenary year of the James Young patent which led to the foundation of the Scottish shale oil industry. The technical sections of the conference will include geology and mining; retorting, refining, and use of by-products; and economics and statistics. The last conference was held in 1938.

Edwin Macfarlan Retires

Edwin J. Macfarlan, assistant to the manager of the foreign trade department, has retired from Standard Oil Company of California after 48 years service. He went to work for Standard in 1901.

For Minimum Antioxidant Treating Costs

Check All 3

Du Pont Gasoline Antioxidants . . . Nos. 5, 6 and 22

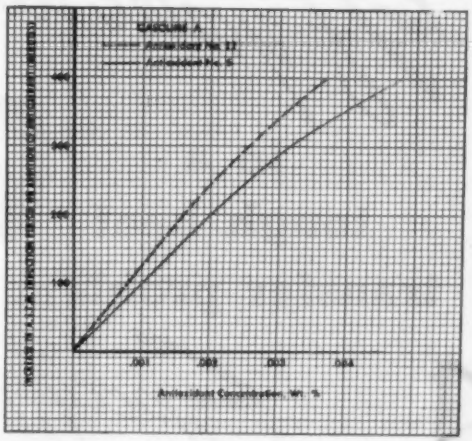
Frequently, there is considerable variation in the antioxidant response of gasolines. It is for this reason that Du Pont offers three gasoline antioxidants . . . Nos. 5, 6 and 22, from which the one best suited to your gasoline can be chosen.

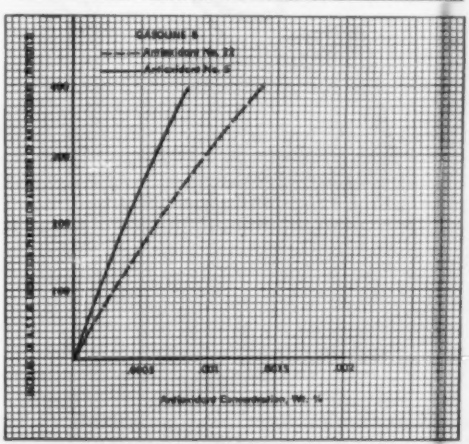
Variation in antioxidant response in two gasoline stocks is illustrated by the graphs at the right. These were taken from our laboratory files and show how in Gasoline "A" Antioxidant No. 22 showed a definite saving over Antioxidant No. 5, and in Gasoline "B" the response was reversed with No. 5, showing an advantage over No. 22. (No. 6 had approximately the same response as No. 5).

Where copper dish gum specification is of importance, it will usually be found that Antioxidant No. 6 provides the most economical control.

If water extraction by tank bottoms or in pipelines is a problem, Antioxidant No. 22, because of its low water solubility, may be the answer.

Let the nearest Du Pont District Laboratory evaluate your fuel and make the proper recommendations for minimum antioxidant treating costs. For samples and further information, ask your Du Pont Petroleum Chemicals representative or write the nearest District Office.





Note: The antioxidant concentration in these graphs is expressed as active ingredient for purpose of direct comparison

Du Pont Antioxidant No. 5—is a solution containing 50% Normal-butyl-para-aminophenol, 30% Anhydrous Iso-propanol, and 20% Anhydrous methanol.

Du Pont Antioxidant No. 6—is a solution containing 50% Iso-butyl-para-aminophenol, 30% Anhydrous Iso-propanol, and 20% Anhydrous methanol.

Du Pont Antioxidant No. 22—is a commercial grade of N,N' disecondary butyl-para-phenylene-diamine containing no solvents.

DU PONT

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT
PETROLEUM CHEMICALS

E. I. DU PONT DE NEMOURS & CO., (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla.; Houston, Texas; Los Angeles, Calif.

District Laboratories: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla., Houston, Texas; El Monte, Calif.

If you're all "gummed up"

in a tough heat transfer problem

Specify..

Vogt Spiral, Spring Type Scraper
Patent No. 2,117,175

Vogt

SCRAPER TYPE

CHILLERS

Photos show shop assembly without driving motor.

Fouling of the inner pipe surfaces of Vogt Chillers is eliminated, because they are swept clean continuously during operation by patented spiral, spring type scrapers. And these clean surfaces achieve the highest possible rate of heat transfer between the solution and the refrigerant.

VOGT DOUBLE PIPE TYPE CHILLERS are designed to use ammonia, brine, or cold dewaxed oil as the cooling medium. Oil or brine, when employed, is circulated through the jacket pipes countercurrent to the flow of the solution in the inner pipes.

MULTI-PIPE TYPE CHILLERS, for direct expansion, have large jacket shells each containing seven inner pipe sections and employ volatile refrigerants such as ammonia, freon, propane, etc.

Our engineering staff is qualified by training and experience to help you find the right answers to your heat transfer problems. Their recommendations are available without obligation.

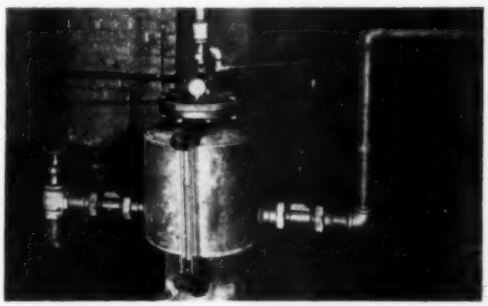
HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE 10, KENTUCKY
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

NEW EQUIPMENT and Manufacturers' Literature

For copies of manufacturers' literature or more information about products described on these pages write to the address shown, using the number shown for each item desired.

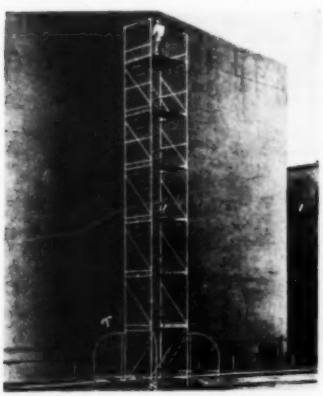
Cycling Jet Pump (Item 525)

A two-part cycle, which is automatically continued until the pump is turned off, enables a Penberthy Injector Company's cycling jet pump to lift by suction and discharge against heads approximately equal to the gas, air or steam pressure used. The pump consists of a receiver tank, float-controlled operating valve, ejector and necessary piping gages and valves. Pressurized gas, steam, or air is used to operate the unit which has no moving parts other than the float-controlled operating valve and two check valves.



For further information write Penberthy Injector Company, 1242 Holden Avenue, Detroit 2, referring by number to this PETROLEUM REFINER item.

Scaffolds (Item 526)



Up-Right Scaffolds, "designed to simplify operations and reduce labor costs, eliminate the need for extension ladders and complicated scaffolding in construction and maintenance work." Made of lightweight aluminum alloy, a seven-foot, "a single section unit can be erected in a minute, a 45-foot multiple unit in 15 minutes." A lock-in feature eliminates wing nuts, bolts, loose parts, and requires no wrenches. Each section folds flat. A foundation area, 4½ by 6 feet is standard with optional outboard supports, available to provide a 10 by 10 foot foundation area.

For further information write Up-Right Scaffolds, 1013 Pardee Street, Berkeley, Calif., referring by number to this PETROLEUM REFINER item.

Pipe Installation (Item 527)

Catalog section M-8801 of National Carbon Company, Inc. explains the installation of brand pipe and fittings and the cements used to bond these products. This section is to be used in connection with "Karbate" Brand Pipe and Fittings Booklet, Catalog section M-8800B.

For copies write National Carbon Company, Inc., 30 East 42nd Street, New York 17, referring by number to this PETROLEUM REFINER item.

Steel Fabrication (Item 528)

A Watkins, Inc. booklet describes the activities, staff, equipment and facilities of the company and discusses typical products which include precipitator equipment, bubble decks, fractionating towers, stainless plates, compressor stations buildings, rigid frames, and tilt pots.

For a copy write Watkins, Inc., Wichita, Kan., referring by number to this PETROLEUM REFINER item.

Buffer Solutions (Item 529)

Manufactured and checked after bottling, to National Bureau of Standards specifications, a new line of buffer solutions for calibrating pH instruments has been developed by Leeds & Northrup Company. Nominal pH values are 4, 7, and 9. Actual values are 4.01, 6.86, and 9.16 at 25° C. Solutions are supplied in one pint unbreakable, non-contaminating, re-usable polyethylene bottles on which are printed pH-temperature calibrations from 0° to 60° C.

For further information write Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 44, referring by number to this PETROLEUM REFINER item.

Valve Controller (Item 530)

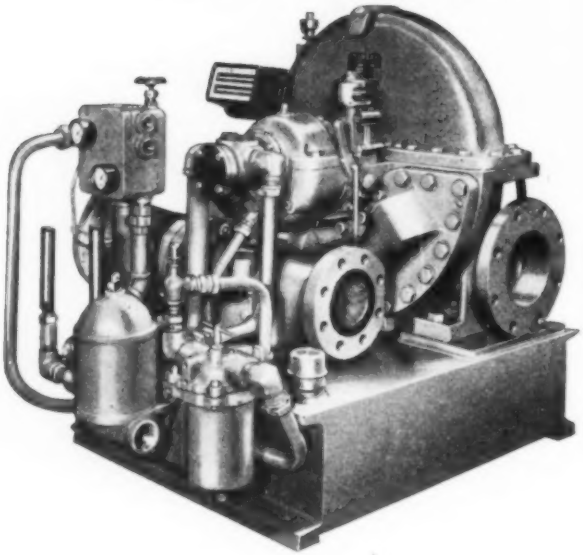
Positrol, a series 3500 valve controller, is offered by Fisher Governor Company. Bulletin 3500 describes construction features, adjustments, principle of operation, mounting and stem connection, characteristics and performance, specifications and dimensions. Also explained are the combination filter-regulator, air consumption rate, maximum recommended supply pressure, speed of action, split range, by-pass and gage assemble. Cross-sections, graphs, schematic drawings and photographs accompany the data.

For a copy write Fisher Governor Company, Marshalltown, Iowa, referring by number to this PETROLEUM REFINER item.

Flame Arrestor (Item 531)

"The danger of flash-back fire in atmospheric storage tanks can be materially lessened by a safety device approved by Underwriters' Laboratories and known as the VVH pressure-vacuum

MURRAY
TYPE S
VARIABLE SPEED
TURBINE



Murray Type S Steam Turbines are well suited to a variety of jobs including those drives requiring variable speed. These turbines may be constructed with hydraulic type variable speed governors and complete pressure lubrication system including reservoir, filter, cooler, oil pressure gauges and thermometers. Turbines so equipped are not only suitable for variable speed operation but for higher operating speeds as well. These features make the Type S variable speed turbine an ideal drive for high speed centrifugal compressors and blowers.

Pictured above is such a machine designed to deliver 400 HP at 7400 RPM. This machine is arranged for speed adjustment by means of hand control or by automatic control. The turbine is also equipped with a vibrating type speed indicator and a remote control tripout device. Note that the construction provides an oil tank of generous oil capacity. The combined base and tank arrangement may be extended for mounting the driven machine if desired.

Write today for full details.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

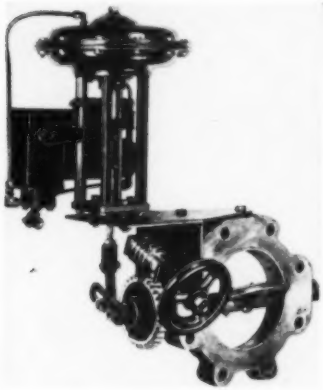
Builders of Steam Power Equipment for Three Quarters of a Century

New Equipment

vent valve." Developed by Black, Sivalls and Bryson, Inc., the valve is constructed with a flame arrestor bank which acts to prevent propagation of flame into storage tanks containing volatile and costly liquids. The arrestor bank is made of rolled aluminum construction. Other features include rubber-to-metal sealing.

For further information write Black, Sivalls and Bryson, Inc., 720 Delaware, Kansas City 6, Mo., referring by number to this PETROLEUM REFINER item.

Butterfly Valves (Item 532)



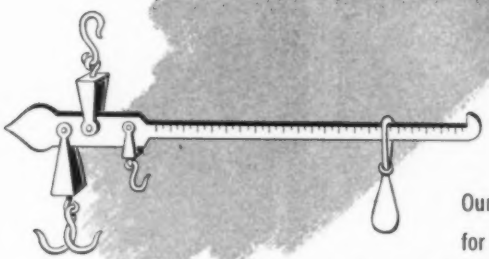
"Roto-Vane" (wafer type), a new line of air-operated valves for process control, have been offered by Fischer & Porter Company in sizes from 3 through 12 inches. Advantages claimed are "great strength, lightness, compactness, convenience and accessibility." Valve bodies are available in carbon steel, bronze, 316 stainless steel, and plastics. The vane is 316 stainless steel, fitted with rubber seal when required. Static line pressures up to 125 psig. and differential pressures up to 50 psig. can be handled. All valves are supplied with hand jack screws, air-operated diaphragms, and valve positioners. The entire assembly is installed in the line with only one set of thru-bolts; the 125-pound drilling is standard.

For further information write Fischer & Porter Company, Hatboro, Pa., referring by number to this PETROLEUM REFINER item.

Sulfur Analysis (Item 533)

Instruments for carbon and sulfur analysis of organic and inorganic materials are described in a bulletin of Harry W. Dietert Company. Explanation of each instrument is accompanied by a photograph and specifications. Included are a two-minute carbon determinator; a cast metal specimen mold, a purifying train, carbon combustion tubes, liner shield, sulfur determinator, a combustion tube with canopy shield, an oxygen drying tower, combustion boats, dual accelerator (tinned copper strips), a varitemp combustion furnace, a hitemp combustion furnace, boat covers, an oxygen regulator, a heat deflector, an analytical bal-

How "heavy" is resourcefulness?



Ours would weigh nearly four billion pounds, for that's how much Attapulgus Fullers Earth and Porocel Activated Bauxite we've shipped to petroleum refiners.

When weighing resourcefulness—as it applies to percolation adsorbents and solid catalysts—two factors are particularly meaningful: First, the desire of all the people in the company family to tackle problems that require particular skill and broad technical knowledge. Second, the company's physical reach—mines, plant equipment, specialized laboratory and engineering facilities—for good men can do no more than their tools permit.

These resources abound at Attapulgus and Porocel. They dovetail to put a firm base under a completely integrated service. And—for world-wide petroleum refining—to put the right adsorbents to work under the right conditions.
May we be of service to you?

ATTAPULGUS CLAY COMPANY *Fullers Earth* · **POROCEL** CORPORATION *Activated Bauxites*

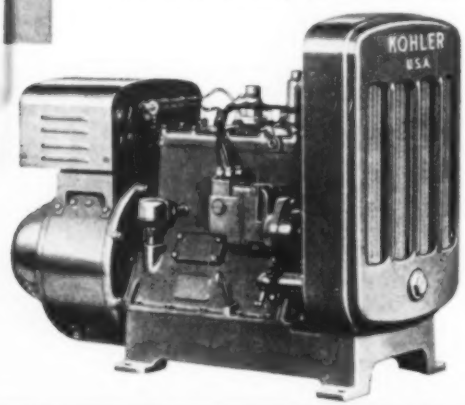
Dept. W, 210 West Washington Square, Philadelphia 5, Pa.

Protect against power failure!

Safeguard lighting, important operations with stand-by KOHLER *Electric Plants*

Costly delays, damaging loss or confusion may result from sudden interruption of your central station electricity, caused by storms, floods, fires, or other mishaps. With Kohler Electric Plants installed at key operating points, you can avoid all such risks. As soon as central station service stops, the Kohler units will *automatically* begin to supply current for emergency lighting, control systems, alarm signals and other essential equipment.

Kohler Electric Plants have a 30-year background of engineering research and experience. They are especially designed to provide the reliable stand-by protection you need. The extreme importance of the protection they give has been proved not only in refineries, but in factories, stores, schools, hospitals, theatres, homes and other places throughout the nation. Sizes range from 350 watts to 10 KW. Write for illustrated folder D-17. Kohler Co., Kohler, Wisconsin. Established 1873.



Model 3A21, 3KW, 115 volt AC. Automatic start and stop. Length 41", width 16", height 27¾".

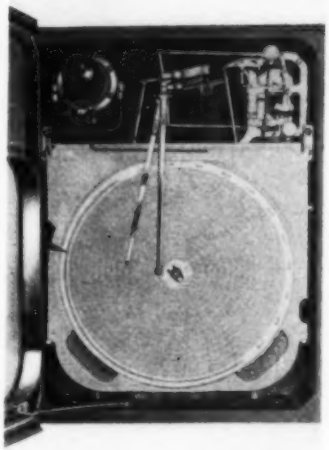
KOHLER OF KOHLER

PLUMBING FIXTURES • HEATING EQUIPMENT • ELECTRIC PLANTS

ance, analytical weights, a sample inserter, a pellet press and a combustion retarder cover.

For a copy of the bulletin write Harry W. Dietert Company, 9330 Roselawn Avenue, Detroit 4, referring by number to this PETROLEUM REFINER item.

Air Controller (Item 534)



Air-operated controllers, series 500, described in Bulletin A120 of The Bristol Company, are available in five models: on-off, proportional, reset, derivative, and reset plus derivative. Also discussed in the bulletin are instruments for automatically controlling temperature, pressure, flow, liquid level, humidity, and pH value. All series 500 reset controllers are equipped with action stops.

For a copy write The Bristol Company, Sales Promotion Department, Waterbury, Conn., referring by number to this PETROLEUM REFINER item.

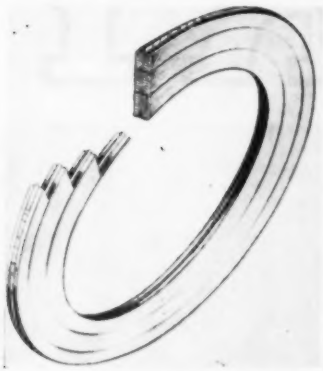
Fittings Protection (Item 535)

A special process called "U-Coat" has been perfected by Union Malleable Manufacturing Company to protect ordinary malleable iron pipe fittings against rust and corrosion. "After being subjected to a continuous stream of salt spray solution for 100 hours, fittings treated with U-Coat show no rust or corrosion at all."

For further information write Union Malleable Manufacturing Company, Ashland, Ohio, referring by number to this PETROLEUM REFINER item.

Compression Gage Gasket (Item 536)

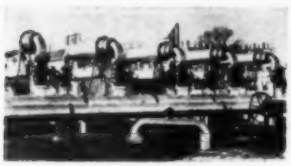
Said to possess the qualities of solid metal without the rigid characteristics of ordinary solid metal gaskets, a flexible all-metal gasket for high pressure and high temperature applications has been developed by Flexitallic Gasket Company. The gasket is available with rings having a thickness of 3/32 and .125 inch. Also introduced by the company is a



compression gage gasket, style CGI, with an inside ring for high pressure service.

For further information write Flexitallic Gasket Company, 8th and Bailey Streets, Camden 2, N. J., referring by number to this PETROLEUM REFINER item.

Gas Scrubber (Item 537)



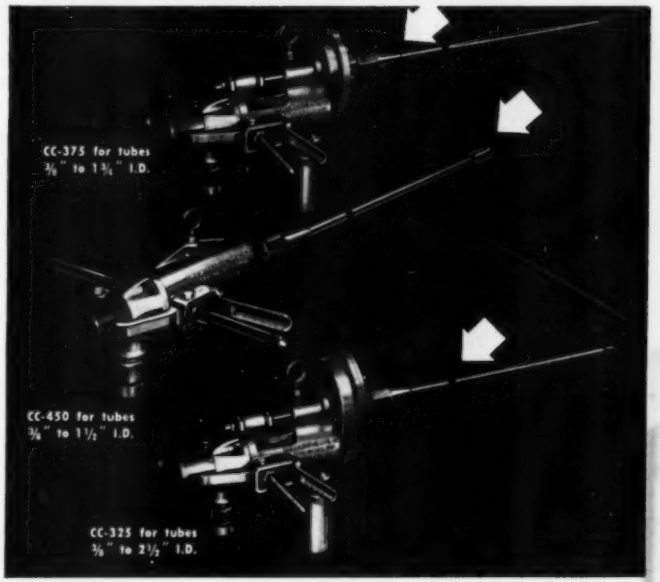
Based on centrifugal precipitation of solids and liquids, the new dry gas scrubber, offered by The Aerotec Corporation, removes liquids and dust. The scrubbers are available in sizes up to 100,000,000 scfd. Scrubbers of vertical design are used to remove either liquids or solids from gas. Horizontal units are primarily for removal of liquids such as water and distillates. On the Big Inch pipe line standard 100,000,000 scfd. units were manifold to give a total capacity of 500,000,000 scfd. at some compressor stations.

For further information write The Thermix Corporation, First National Bank Building, Greenwich, Conn. (project and sales engineers for The Aerotec Corporation also of Greenwich, Conn.), referring by number to this PETROLEUM REFINER item.

Tube Expanders (Item 538)

Thomas C. Wilson, Inc.'s Bulletin 380 describes the complete Wilson-Dudgeon line of tube expanders for high pressure boiler tubes, super-heaters, economizers, water walls, circulating tubes, downcomers and risers in stationary and marine steam generators. Included are Model 38 tube expanders for tubes 1 to 4½ inches o.d. with various roll lengths for tube sheets ½ inch and up in thickness. Also discussed are how the expanders roll and flare tubes in one operation, holding rolls at the correct angle

these Condenser Cleaners



PUT MORE LIFE into small tubes

Stretching the life of small tubes is an AIRETOOL specialty. A clean unit means more efficient heat transfer. The *right* cleaning gear plus regular attention assures refineries maximum tube life—minimum maintenance cost—more economical operations.

AIRETOOL outside mounted cleaners are *right* for your condenser and heat exchanger tubes. Teamed up with the *right* type of drill head, they meet every scale condition. The CB type drill (illustrated) has a carbide metal tip—will remove concrete-hard scale with perfect safety.

CB Drill removes hardest scale even when tubes are completely plugged.

Special features of these cleaners include:

- handle valve which gives operator quick, positive control.
- water feeding device to keep drill head cool and scale cuttings flushed out.
- sturdy lightweight alloy steel construction.
- powerful air driven motor.

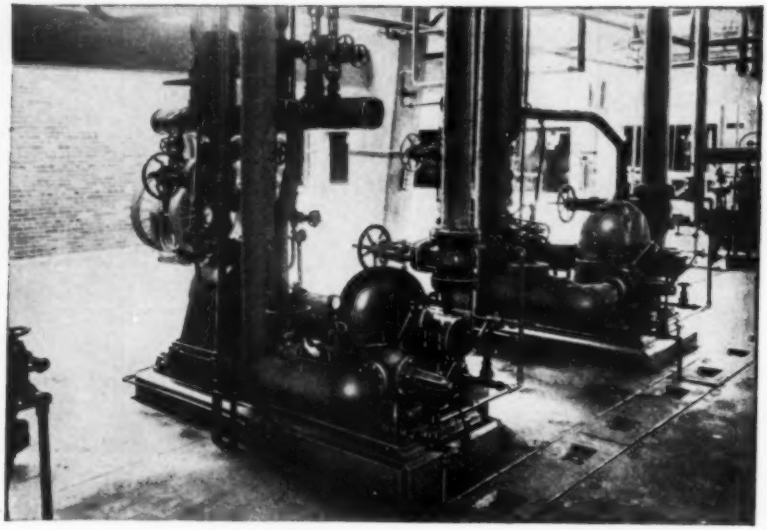
Insist on AIRETOOL tube maintenance gear. Cash in on longer tube life . . . lower maintenance costs . . . more economical operation. For full particulars write The AIRETOOL Manufacturing Co., 316 S. Center St., Springfield, Ohio.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

There's an AIRETOOL tube cleaner and tube expander for every type of tubular construction.

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, HOUSTON, TULSA, BATON ROUGE. REPRESENTATIVES IN PRINCIPAL CITIES.

TERRY



THE ROTORS OF THESE 75 H. P. TERRY TURBINES ARE DOUBLE RIM PROTECTED

The two 75 H.P. Terry Turbines shown above (in the plant of a leading refiner) employ the Terry Solid Wheel Rotor. The wheel is made from a single steel forging and the buckets are milled directly into the wheel. — All as shown in the illustration at the left.

The buckets are protected by rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

This feature and many others of the Terry Wheel Turbine are fully discussed in our Bulletin S-116.

T-1169

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

to mandrel for proper rate of feed and for quick release of the mandrel.

For a copy write Thomas C. Wilson, Inc., 21-11 44th Avenue, Long Island City 1, N. Y., referring by number to this PETROLEUM REFINER item.

Horizontal Turbine (Item 539)

In September's PETROLEUM REFINER, an incorrect cut was furnished for Whiton Machine Company's horizontal turbine, correct picture of which appears herewith. It shows the horizontal turbine which was designed to deliver 500 bhp. at 1750 rpm. with 850 to 900 pounds initial pressure, 850 F. TT and to exhaust into a vacuum of 12 inches, or against 2 psig. back pressure. Pedestals support the casing near the centerline. Other features include an oil relay actuated constant speed governor, separate emergency governor of the poppet type, gear-driven oil pump to supply oil for the governor and the turbine bearings, external oil cooler, automatic back pressure trip and standard accessories.

For further information write Whiton Machine Company, New London, Conn., referring by number to this PETROLEUM REFINER item.

Fire Extinguisher (Item 540)

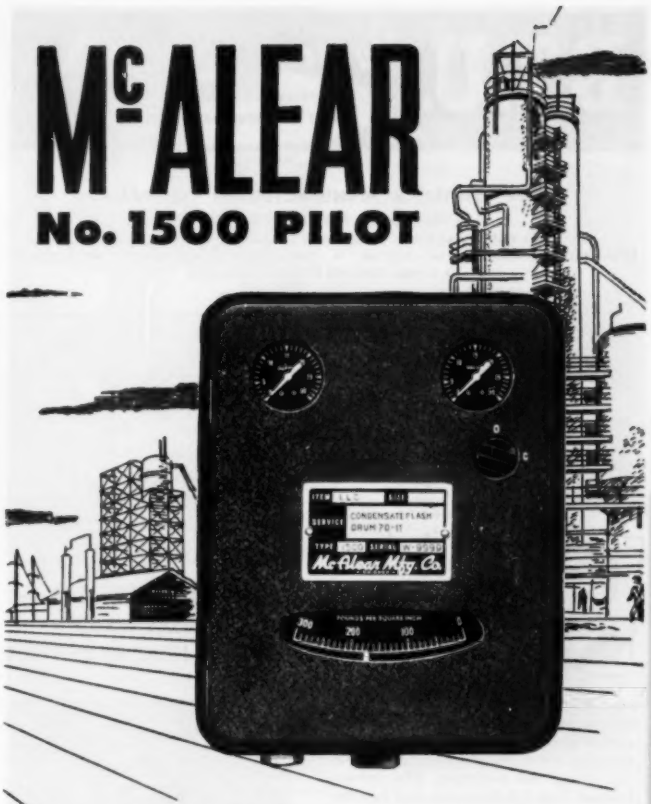
American-LaFrance-Foamite Corporation has manufactured a new line of 2½-gallon silicon bronze fire extinguishers with monotype construction shells. They are foam, soda-acid, and anti-freeze water types, approved by Underwriters' and Factory Mutual Laboratories. "With an ultimate shell strength of 1400 psi., these new units are 65 percent stronger than previous Alfco drawn-shell models, twice as strong as welded silicon bronze units, and 2½ times stronger than fabricated copper extinguishers."

For further information write American-LaFrance-Foamite Corporation, Elmira, New York, referring by number to this PETROLEUM REFINER item.

Hot Water Heater (Item 541)

A. Gunthard Company's hy-flow heater, specially built in accordance with the ASME-API or ASME code for 150-pound working pressure, is recommended for producing hot water "in large quantities instantly and noiselessly." Nine different normal sizes are available. Capacities range from 3,960 to 31,500 gallons per hour. It is claimed that the

McALEAR
No. 1500 PILOT

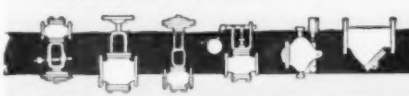


Here's the ultimate in accuracy of control for pressure reducing, back pressure, pressure relief, vacuum, vacuum relief, pump governor regulation or boiler fuel governor service. It is the new McAlear 1500 PILOT which reduces hysteresis to a minimum through use of a spiral sensitive spring in place of the conventional "C" gauge spring.

The No. 1500 PILOT may be mounted either above the valve it operates or remotely on a panel (surface or flush) without alteration. No tools required for adjustment of throttling band or for conversion from direct to reverse action.

Installed with the McAlear No. 115 or 116 Diaphragm Motor Valve (left), it gives you a completely coordinated "package" for sensitivity control. Write for bulletin No. 150.

McALEAR Mfg. Co.
1905 SOUTH WESTERN AVENUE
CHICAGO 8, ILLINOIS



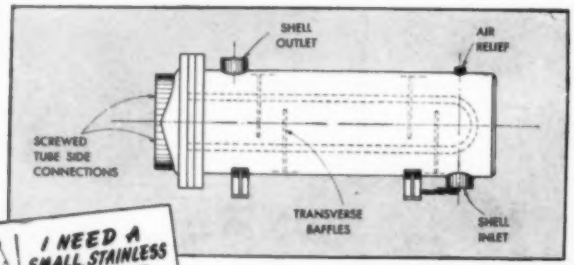
McALEAR controls
for STEAM WATER AIR OIL-GAS

REPRESENTATIVES IN PRINCIPAL CITIES
AN INDEPENDENT MANUFACTURER FOR OVER 40 YEARS

B.T.U. digest

THROWING LIGHT ON HEAT TRANSFER PROBLEMS

THE WHITLOCK MANUFACTURING COMPANY
149 BROADWAY, NEW YORK 6, NEW YORK
Main Office and Plant, 75 South St., Elmwood, Hartford 2, Conn.
NEW YORK • CHICAGO • BOSTON • PHILADELPHIA • DETROIT • RICHMOND
In Canada: DARLING BROS., LTD., Montreal



BY POPULAR REQUEST—
A STANDARDIZED MULTIPURPOSE HEAT EXCHANGER

Recognizing an urgent demand for a small, multipurpose heat exchanger we have standardized on what we believe is the optimum design for almost universal application—heating, cooling, and condensing. This standard Whitlock Type 1-R-2 stainless steel tube side unit shown above is now available for prompt shipment.

WIDE RANGE OF CAPACITIES

The exchanger is fabricated in 3 shell sizes and 3 tube lengths to provide a total of 9 selections ranging in size from 8 to 50 sq. ft. Where more surface is required multiple units may be connected in series or parallel.

MATERIALS OF CONSTRUCTION

The shell is of steel, with Type 304 stainless steel tubes (⅝" OD x 18 BWG), tube sheet, and cast channel. Baffle spacing of 3" develops reasonably high shell side velocities.

U-TUBE DESIGN

The Whitlock Type R or U-tube construction allows operation with relatively high differential shell and tube side temperatures—permits individual thermal expansion. The U-tube design, suitable for a wide range of service, also makes a unit that is low in cost. This Type 1-R-2 Exchanger may be exactly what you want—write today for additional information.

RECENT GROUP OF CALANDRIAS

These 700 sq. ft. straight tube, fixed tube sheet calandrias were recently built by Whitlock. The liquid to be evaporated circulates through the tubes, with steam in the shell side. Construction is of steel throughout and dimensions are 31" I.D. by 8'8" long overall. Design pressures: shell side 300 p.s.i., tube side 150 p.s.i. The units were furnished complete with fabricated reducing channels and supporting bases as required. Whitlock can design and build special heat transfer equipment to exactly meet your needs!

WHITLOCK

DESIGNS and BUILDS Boards • Coils • Condensers • Coolers • Heat Exchangers
Heaters • Piping • Pressure Vessels • Receivers • Reboilers

New Equipment

heater can be regulated automatically with low maintenance and replacements. The heater can be installed and used where large quantities of steam and water are available.

For further information write A. Gunthard Company, Ennis, Texas, referring by number to this PETROLEUM REFINER item.

Welder (Item 542)

"The Fleetwelder 200," an industrial type NEMA rated welder of The Lincoln Electric Company, with reserve capacity over its rated maximum load of 250 amperes, because of its arc booster and reserve capacity, is suited for both job shop welding and industrial welding. Electrodes ranging in diameter size from 5/64 to ¼ inch may be used with it. Inclosed in a pressed steel case standing 25 inches high, the unit features a patented reactor control which eliminates dead air space; no moving coils or leads in the windings; copper windings insulated with spun glass and mica separators, placed in a welded steel laminated frame.

For further information write The Lincoln Electric Company, Cleveland 1, O., referring by number to this PETROLEUM REFINER item.

Hydrometers (Item 543)

Laboratory thermometers and hydrometers are discussed in Catalog 1100E of C. J. Tagliabue Corporation. Listings include TAG standard grade, ASTM, etched stem thermometers, TAG certified and API hydrometers, and Fahrenheit-Centigrade conversion tables.

For a copy write C. J. Tagliabue Corporation (New Jersey), 614 Frelinghuysen Avenue, Newark 5, N. J., referring by number to this PETROLEUM REFINER item.

Fatty Acid Esters (Item 544)

W. C. Hardesty Company is offering data sheets which give in chart form the specifications and respective solubility

1 **Integral Stellite Seats**—permanent, hard, corrosion and wear resistant.

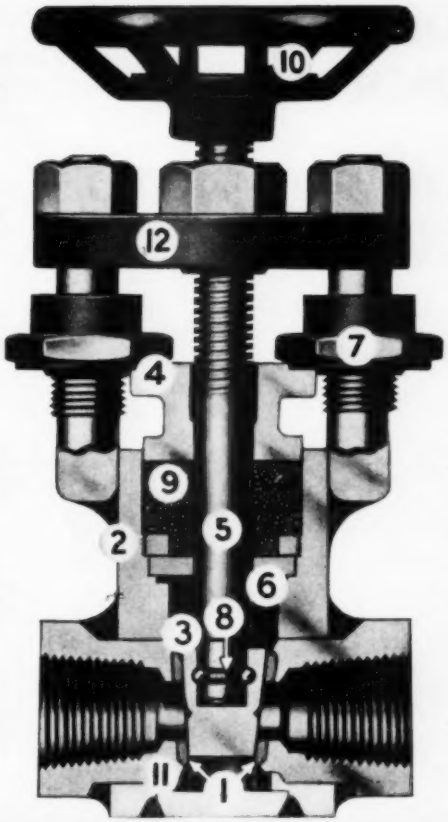
2 **No Bonnet Joint**—no leakage, no gasket trouble. Lagging costs minimized.

3 **Dissimilar Materials In Seats and Wedges**—an extra guarantee of long-life, no galling.

4 **Self-Storing Gland**—no wiring or tieing in place. A "plus" for the operator.

5 **No Stem Pitting**—all stem completely coated with a heavy cadmium plating.

6 **Stainless-To-Stainless Seat Seating**—allows stuffing box shut-off around stem when valve is fully opened.



7 **Gland Nut Threads Protected**—the length of the nuts is greater than their maximum travel.

8 **Ball Bearing Stem-To-Wedge Connection**—even distribution of load, easy operation, longer wear, less friction.

9 **Packing Ease**—plenty of packing space, packing of the highest quality, for the widest range of services.

10 **Safe, Comfortable Handwheel**—sleekly scalloped for easy, sure and comfortable grip.

11 **Interchangeable Parts**—all wedges, stems and thread bushings to exacting, absolute uniformity.

12 **Baked Enamel Exterior Finish**—complete protection from corrosion of all external parts.

TOUGH and TIGHT

They're known, in a large oil company, as "those tough and tight valves" . . . they combine twelve superiorities available in no other valve . . . they're modern in every detail even to the safe, comfortable, sleekly scolloped hand wheel. They're the *general purpose* Hancock Steel Gate WELDVALVES . . . Check them for yourself. You'll find that Hancock Gate WELDVALVES will take the toughest services, stay tight month-after-month . . . Costing no more than ordinary valves, Hancock Gate WELDVALVES give you integral stellite seats that mean years of trouble-free operation; a modern, functional design that eliminates bonnet leakage and gasket troubles, and ten other reasons why their usage is growing every day . . . Hancock Steel Gate WELDVALVES are designed for 800# at 750 deg. F. or 2000# at 100 deg. F. Sizes up to 2 inches.

Write today for the new Bulletin 202 on General Purpose Hancock Steel Gate WELDVALVES.

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

HANCOCK *Valves*

1877 HANCOCK U.S.A.

A PRODUCT OF

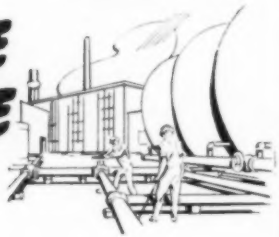
MANNING, MAXWELL & MOORE, INC.

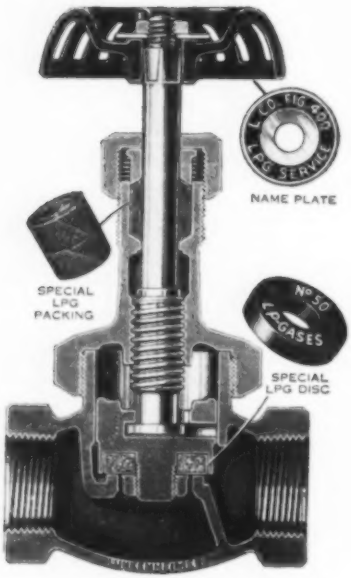
WATERTOWN 72, MASSACHUSETTS

Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Micronsen' Electrical Instruments, Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

POSITIVE CONTROL with LUNKENHEIMER VALVES

FOR DEPENDABLE LP GAS SERVICE





400 lb. W.O.G. (Water-Oil-Gas)
Fig. 400, GLOBE
Fig. 401, ANGLE

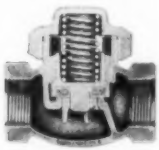


Fig. 403
LIFT CHECK WITH SPRING

Fig. 402
LIFT CHECK

For Liquefied Petroleum Gases . . . in LP-Gas systems, bulk transfer and storage tanks, domestic cylinder charging manifolds, vapor differential compressors and the many industrial uses . . . Lunkenheimer 400 lb. LPG Valves meet every need. Designed for this service and reflecting Lunkenheimer Quality throughout, these rugged valves have special packing, and in globe, angle and check valves, a special, easily renewable non-metallic disc. These valves are approved by Underwriters' Laboratories, Inc., for LP-Gas.

LUNKENHEIMER DISTRIBUTORS are located in all oil producing and refining centers. Write for Bulletin 576, or ask your distributor for a demonstration of Lunkenheimer Valves for Liquefied Petroleum Gases.

Fig. 404
Bronze Union Bonnet Gate Valve
400 lb. W.O.G.
¼ in. to 3 in.

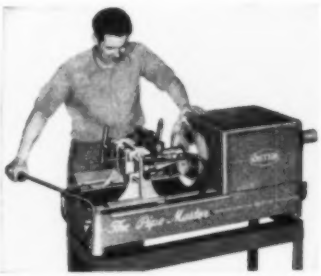
ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO, U.S.A.
NEW YORK 13 · CHICAGO 6
BOSTON 10 · PHILADELPHIA 34
EXPORT DEPT., 318-322 HUDSON ST., NEW YORK 13, N. Y.

New Equipment

in oils, solvents and waxes of various molecular weight polyethylene glycol, mono and di stearates, laurates and oleates and various glycerol and glycol esters of fatty acids. Tentative specifications for each ester include color, melting point, free fatty acid, iodine value, saponification value and solubility in water, kerosine, naphtha, methanol ethanol, ethyl acetate, acetone, vegetable oil, mineral oil and paraffin wax.

For copies of the charts write W. C. Hardesty Company, Inc., 41 East 42nd Street, New York 17, referring by number to this PETROLEUM REFINER item.

Threading Machine (Item 545)



Known as the Oster No. 522 De Luxe "Pipe Master," a threading machine of aluminum construction has been developed by The Oster Manufacturing Company. It has a regular pipe range of ¼ to 2 inch pipe; extra range of ⅛ inch pipe; extended range of 2½ to 8 inch pipe when used with drive shaft and geared die-stock; and a bolt range of ¼ to 1½ inch. Designed for light socket connection, the machine is furnished with a universal geared head motor and safety switch for operation on 110 volt, either ac. single phase or dc. Two stationary, quick-opening, adjustable dieheads are included along with replaceable flat bedways and hinged mounting of motor, switch and pump. A front chuck, the "Spinfast" eliminates the need of a chuck wrench. Net weight is approximately 299 pounds.

For further information write The Oster Manufacturing Company, Cleveland 3, Ohio, referring by number to this PETROLEUM REFINER item.

Refractory Materials (Item 546)

Properties, typical applications and other information are included in a reference table of Walsh Refractories Corporation's new bulletin. Also featured are Mullitex fire brick and Multitex RB, special duty refractory.

For a copy of the bulletin write Walsh Refractories Corporation, Department M, 101 Ferry Street, St. Louis 7, referring by number to this PETROLEUM REFINER item.

Gage Accessories (Item 547)

Features and accessories of Jerguson Gage & Valve Company gages and valves described in a company catalog section include quick-closing valves; equalizing plate for lever-operated quick-closing

valves; chain and indicators; optional gage and valve connections and close hook-ups; double seating stems; drain valves; outside screw and yoke drain valve; end stems; tubular gage glass protectors; scales and gage illuminators.

For further information write Jerguson Gage & Valve Company, 80 Fellsway, Somerville 45, Mass., referring by number to this PETROLEUM REFINER item.

Air Flow Meter (Item 548)

A highly sensitive vane type air-flow meter, for pressures up to 60 psi. and flow rates to 50 cpm. is offered by Seico, Incorporated. This model B-1050 features a flexible metal liner in the flow chamber. Curvature of the liner is controllable by external adjustments to determine the characteristics desired on the scale. Over-all dimensions are 6⅛ inches diameter by 4 1/16 inches thick. The instrument dial is 4¼ inches diameter with a 6¼ inch scale length. Strong zero vane torque is accomplished by weighting the vane tip, which also provides vernier adjustment to the range scale limits.

For further information write Seico, Incorporated, 10212 E. S. Hoyne Avenue, Chicago 43, referring by number to this PETROLEUM REFINER item.

Bis (Trifluoromethyl) Benzene (Item 549)

Pilot plant production of bis(trifluoromethyl)benzene (xylene hexafluoride) is under way at Hooker Electrochemical Company. The product, a mixture of the para and meta isomers, has a specific gravity at 20° C. of 1.395, a freezing range of —40° to —50° C., a distillation range of 113° to 117° C. and a flash point of 37° C.

For a copy of Technical Data Sheet No. 368 write Hooker Electrochemical Company, Niagara Falls, N. Y., referring to this PETROLEUM REFINER item.

Spray Insulation (Item 550)

It is claimed that "one application of type "D" insulation No. 553 of Insul-Mastic Corporation of America insulates, waterproofs, rustproofs, deadens sound, prevents condensation and resists fire." A company catalog discusses the composition of the insulation; applications; spraying machines; the "K" factor; condensation; fire and heat resistance; resistance to acids and alkalies; augmenting and decorating type "D"; and specific uses and service records.

For copy write Insul-Mastic Corporation of America, Oliver Building, Pittsburgh 22, referring by number to this PETROLEUM REFINER item.

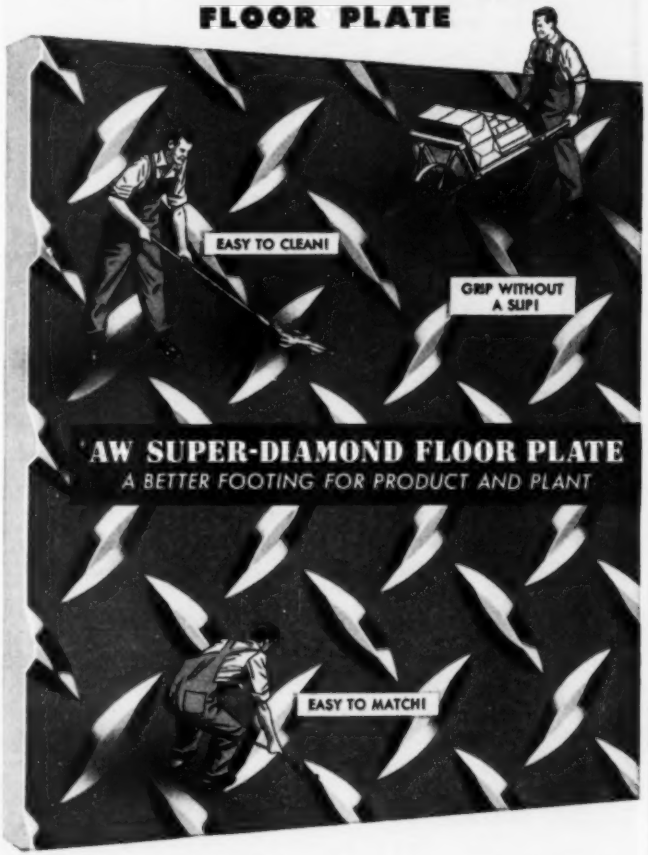
Hydraulic Cylinders (Item 551)

Hydraulic actuating cylinders for the operation of gate valves are discussed in Bulletin CS-1049 released by Ledeen Manufacturing Company. Applications of these cylinders to hot oil lines in refinery work is also covered in Bulletin

Foundation for Safety

AW SUPER-DIAMOND

FLOOR PLATE



So easy to plan and build with—so safe and inexpensive. Exclusive engineered design, with Super-Diamonds at 45° angles, gives grip-without-a-slip safety and makes plates easy to match without waste. Use it for safe, strong, clean loading platforms, fire escapes, walkways, trench covers, running boards, machine tool bases and other product and plant applications.

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16 Page Catalog L-58. It's packed with useful information. Write now.

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CONSHOHOCKEN, PA.

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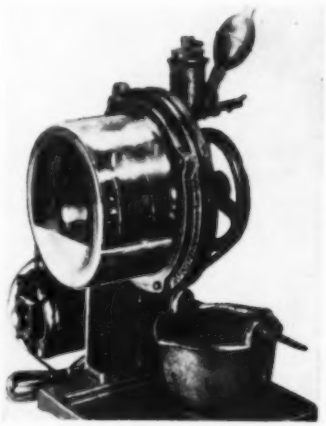
New Equipment

453 along with cylinder details, installation information, dimensions, capacities, weights, applications, and other engineering data. The cylinders, for use with 24- and 30-inch diameter gate valves, are mounted on derrick type brackets which in turn mount on gate valves. Ports on the cylinders are connected to a 500 psi. hydraulic pump and reservoir through suitable four-way valves.

For copies write Ledeen Manufacturing Company, 1600 South San Pedro Street, Los Angeles 15, referring by number to this PETROLEUM REFINER item.

Mercury Oxifier (Item 552)



Andrew Technical Service has manufactured a motor-driven mercury oxifier capable of handling 25 pounds or less. It is claimed that after treatment, the mercury is suitable for use in McLeod gages, manometers, and displacement devices. The oxifier does not employ either vaporization or treatment with chemicals, but oxidation of impurities by air. In the process which takes several hours, the mercury is violently agitated in a manner to produce a thick spray in the air space of the glass barrel. Air is carried down into the body of the mercury, and the skin formations are repeatedly broken up to release microscopic particles of mercury which they entrap.

For further information write Andrew Technical Service, 4747 N. Damen Avenue, Chicago 25, referring by number to this PETROLEUM REFINER item.

Enclosures (Item 553)

Bigelow-Liptak Corporation industrial furnace enclosures and vessel linings for oil refinery furnaces are described in a company catalog. Designed to reduce heat losses and air infiltration, these units are applicable to the following: a typical oil heater; an "A-Frame" furnace; an end-fired heater with overhead convection bank; an "upshot" heater; a cylindrical heater; an equiflux furnace; a high-pressure reactor vessel; a catalyst regenerator vessel; an oil- and gas-fired low-head vent-tube boiler arranged for preheated air recovery; and HRT boil-

This HOMESTEAD VALVE opens or closes instantly . . . every time . . . any time

IT'S STICK-PROOF BECAUSE IT'S LEVER-SEALD

HOMESTEAD LEVER-SEALD QUARTER-TURN VALVES have been first choice for more than 16 years in services where extremes of temperature or pressure, or corrosive fluids, cause ordinary valves to "stick" or "seize".

They are "stick-proof" because built into each valve is a powerful lever-and-screw device that prevents sticking and assures positive action at all times under all conditions.

They operate faster too, than screw-stem type valves . . . 16 to 28 times faster. And the quarter-turn principle makes them ideal for installation in restricted areas, next to walls, floors, ceilings, congested piping and other obstructions where other types of valves could not be used. Next time you have a sticking or damaged valve replace it with a Homestead LEVER-SEALD Quarter-Turn Valve. You'll never be satisfied with ordinary valves again.

Homestead Lever-Seald Quarter-Turn Valves are available in metals and alloys to suit your needs in sizes from 1½" to 10" for pressures from vacuum to 1500 lbs.

- Instant Stick-Proof Operation.
- Quarter-turn fully opens or closes.
- Seating surfaces always protected. Corrosion practically eliminated.
- Unobstructed straight-line fluid flow.
- All moving parts protected from effects of service conditions and weather.

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892"

P. O. BOX 16 CORAOPOLIS, PA.

For full particulars send for "Valve Reference Book No. 39-3." Write today.

ers. A full-page cross-section drawing accompanies the explanation of each type.

For a copy write Bigelow-Liptak Corporation, 2842 West Grand Boulevard, Detroit 2, referring by number to this PETROLEUM REFINER item.

Castings (Item 554)

Corrosion resistance of stainless, monel and nickel castings is described in a new bulletin of The Cooper Alloy Foundry Company. A comprehensive data sheet, prepared by N. S. Mott, chief chemist and metallurgist, is designed primarily to aid materials engineers in their selection of the best alloy when the corrosive agents and conditions are known.

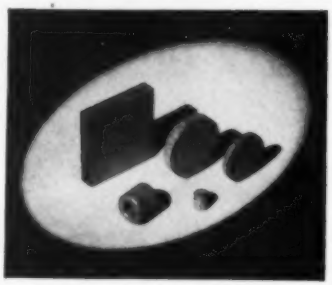
For a copy write The Cooper Alloy Foundry Company, Hillside 5, N. J., referring by number to this PETROLEUM REFINER item.

Caustic Soda (Item 555)

A new edition of Bulletin 6, "Caustic Soda," released by Solvay Sales Division, Allied Chemical and Dye, contains information on the properties of caustic soda and its solution; the nature and advantages of liquid caustic soda, and how to unload and handle it. Photographs, tables, graphs and diagrams accompany the data.

For a copy write Solvay Sales Division, Allied Chemical and Dye Corporation, 40 Rector Street, New York, referring by number to this PETROLEUM REFINER item.

Filters (Item 556)



Stainless steel filters, offered in disc, sheet, plain cylinder, and cone shape, by Amplex Manufacturing Company, have controlled porosity or permeability which may range from nearly zero to more than 60 percent depending upon the application. It is claimed that these filters are efficient for filtering, separating, diffusing, and regulating the flow of liquids, gases and corrosive materials.

For further information write Amplex Manufacturing Company, Division of Chrysler Corporation, Detroit 31, referring by number to this PETROLEUM REFINER item.

Gas Analyzer (Item 557)

An automatic recording gas analyzer, which utilizes the infra-red-absorption characteristics of gas to obtain continuous determination of the critical component in a gaseous stream, is described in the new edition of Baird Associates, Inc. Bulletin XXXI. Construction and operating principle of the infra-red gas analyzer is included with optical diagrams of three-cell and four-cell instruments as well as typical sensitivity curves for carbon dioxide, carbon monoxide, methane, and acetylene. Applications, operating characteristics and physical specifications are also given.

For a copy write Baird Associates, Inc., 33 University Road, Cambridge 38, Mass., referring by number to this PETROLEUM REFINER item.

Gas Absorbers (Item 558)

"Agitated Gas Absorbers," a paper by Kenneth S. Valentine, published by The Patterson Foundry & Machine Company, discusses processes for which gas absorption apparatus of the mechanical agitator type are best suited, and includes drawings of gas absorption systems with examples of the reactions for which they can be used successfully. Also explained are the reactions resulting in the formation of solids, reactions where there are solids in suspension, and various special industrial gas absorption reactions.

For a copy write The Patterson Foundry & Machine Company, East Liverpool, Ohio, referring by number to this PETROLEUM REFINER item.

Rotary Blowers (Item 559)

Bulletin 21-B-37 of Roots-Connersville Blower Corporation explains the smaller size Type AF rotary positive blowers for pressure or suction service. Construction features and operating advantages of rotary positive blowers are also discussed. Included are single pulley, multiple V-belt, direct-coupled, and integrally mounted motorized variable speed driv-

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OF BUBBLE CAPS AND RISERS?

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DIES ARE ON HAND for 200 STANDARD STYLES

Upon request, we will send you a bulletin listing complete specifying data on 200 standard styles of bubble caps and risers furnished by The Pressed Steel Co. With dies on hand for this wide range of styles, it is entirely likely that we can save you the die costs on your bubble cap requirements. Caps to meet special needs will be promptly designed. PSC bubble caps are fabricated from the complete list of alloys which are available today. This enables us to meet any specific corrosion or coking problems. Also welded alloy tubing, conveyor flights, etc., to any design or metal specifications.

An important supplier of welded alloy equipment to the refining industry for almost a quarter of a century, Pressed Steel Co. offers you a wealth of experienced engineering assistance and production know-how. Send blue prints or write as to your needs.

NEW LE JONS BUBBLE CAP ASSEMBLY SAVES 7 WAYS

PSC bubble caps and risers are furnished for all methods of tray assembly. Included is the new Le Jons method, which features unprecedented simplicity and saves in 7 ways. Let us send you data on the 200 standard styles of PSC caps and risers, and our assembly methods.

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of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

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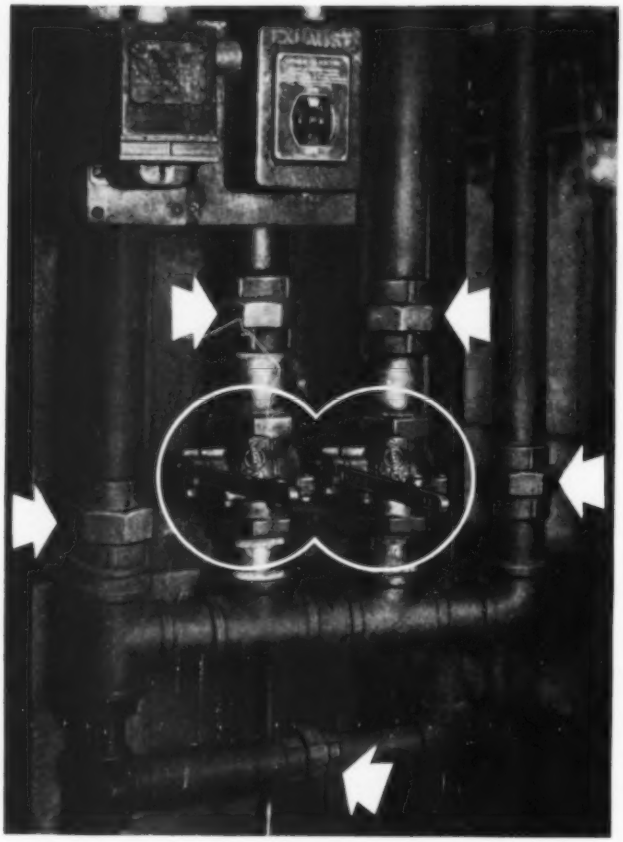
Last 4 Times Longer!



ROCKWOOD
Ball Type
VALVES

. . . provide efficient, time-saving service on quenching lines for annealing furnaces at Revere Copper and Brass Incorporated.

In any plant, *it costs money to constantly repair or replace valves,* whether it's one or a hundred. Rockwood offers you a new ball type valve that is designed and built to cut maintenance costs, increase production output and give longer *leak-proof* service. Many plants like this one have found that Rockwood Ball Valves save time, cost less to operate, stay in service longer and give positive shut-off.

These two Rockwood Valves shown in the picture are opened and closed 60 times a day under 100 p.s.i. Unfiltered river water flows thru the valves and under this severe condition both valves have lasted *4 times longer* than any other make of valves. This same plant is also equipped with Rockwood Cold Forged Steel Unions. Rockwood Ball Valves are available in bronze in pipe sizes from ½" to 2" for 300 p.s.i. working pressure.

For further details and uses, see your distributor or write to the factory direct for bulletin V-4.

CHECK THESE 3 OUTSTANDING FEATURES

1. FULL ROUND FLOW
2. LEAK PROOF SERVICE
3. QUICK OPENING AND CLOSING

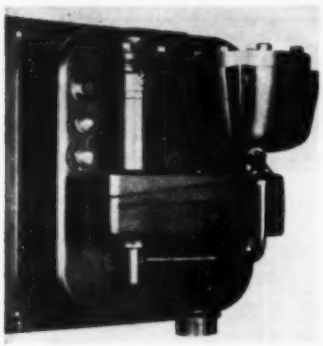
ROCKWOOD SPRINKLER CO

102 HARLOW STREET WORCESTER 5, MASS

ing unit. A selection table, covering the capacity and pressure range of each blower size is included in the bulletin, together with a dimension print that gives complete details on all standard sizes.

For a copy write Roots-Connersville Blower Corporation, 900 West Mount Street, Connersville, Ind., referring by number to this PETROLEUM REFINER item.

Flow Meter (Item 560)



Featuring a magnetic clutch to transmit the movement of the float instead of the conventional mechanical arrangements, the Hays-Penn Magna-Clutch flow meter of The Hays Corporation is described with specifications and dimensions in Bulletin 49-915. The float measures 3.75 inches in diameter. Long float travel is 1.5 inches. No stuffing box is used as movement of the float is transmitted through a pressure-tight manometer by means of the magnetic clutch. Five range tubes give rangeability from 17 to 750 inches water differential. Working pressures are given as 1500 psi. and 2500 psi. (convertible in the field). Six types or combinations of recording, indicating and integrating meters are offered.

For a copy write The Hays Corporation, Michigan City, Ind., referring by number to this PETROLEUM REFINER item.

Iron Castings (Item 561)

Illustrated with ten sketches and photographs, a reprint of Air Reduction Sales Company, entitled, "Repairing Gray Iron Casting By Welding," offers practical case histories covering the repair and maintenance by welding of cast parts. It contrasts the oxyacetylene welding, electric arc welding and carbon arc welding processes as applied to a forging hammer anvil base and other cast parts of industrial equipment.

For a copy write Air Reduction Sales Company, 60 East 42nd Street, New York 17, referring by number to this PETROLEUM REFINER item.

Glass Thermometers (Item 562)

Etched stem glass thermometers having ranges from minus 120° F. or C. up to 1160° F. or 620° C., armored thermometers, ASTM and other special-use thermometers are described in an H-B Instrument Company bulletin.

For a copy write H-B Instrument Company, 2633 Trenton Avenue, Philadelphia 25, referring by number to this PETROLEUM REFINER item.

Heating Jackets (Item 563)

Featuring a safety thermostat which automatically breaks the circuit when the jacket temperature reaches approximately 370° C. or 700° F., a Gyco heating jacket is described in a bulletin of Scientific Glass Apparatus Company, Inc. Built-in iron-constantan thermocouples are covered with color-coded fiberglas insulation for temperature readings with a suitable pyrometer. Four types of jackets are listed with sizes, price and wattage including the hemispherical jackets with or without elements and micro heating jackets Twelve applications are described and pictured for use with Griffin beakers, Pyrex brand jars, and dessicators, Buchner funnels, 60° funnels, Kjeldahl, Erlenmeyer, resin reaction, and flat bottom vacuum distilling flasks, and the Gyco pyrometer.

For a copy of the bulletin write Scientific Glass Apparatus Company, Inc., Bloomfield, N. J., referring by number to this PETROLEUM REFINER item.

Tube Fittings (Item 564)

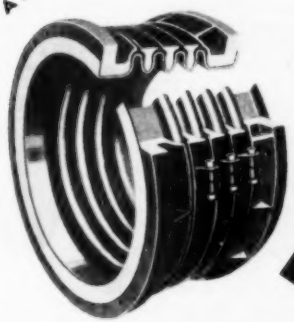
A new line of tube fittings, offered by The Parker Appliance Company, is described in Catalog 203. Design data, specifications, materials and general dimensional data are listed for fittings for hydraulic and fluid-handling systems as follows: triple-lok, triple, triple double

ANOTHER REASON WHY

Badger

IS FIRST IN expansion joints

FLEXIBLE



To refiners and other petroleum processers, flexibility is the *one* most important feature of an expansion joint. Here, once again, Badger Joints stand first.

Fast response to the thrust produced by heat expansion means less wear, tear and breakage on refining and processing equipment and fittings. Just one reason why leaders in the petroleum industry put their faith in Badger Packless Expansion Joints. Here are others:

- **Packless . . . single tube construction provides pressure-tight joint without packing.**
- **Fabricated from stainless steel or alloys . . . joints withstand the high temperatures and corrosion encountered in oil refineries and other petroleum processing plants.**
- **Controlled Heat Treating . . . assures corrosion-resisting qualities for long life.**
- **Compact . . . require no more space than regular flanged fittings.**
- **Special forming methods . . . no danger of structure-weakening stresses.**
- **Directed flexing rings . . . to equalize stresses *between* and *within* corrugations.**

These features are important in any pipe line job . . . you can get them *all* only by specifying Badger Expansion Joints.

Write today for Bulletin 100 (self-equalizing type) or Bulletin 200 (non-equalizing type).

Badger MANUFACTURING COMPANY

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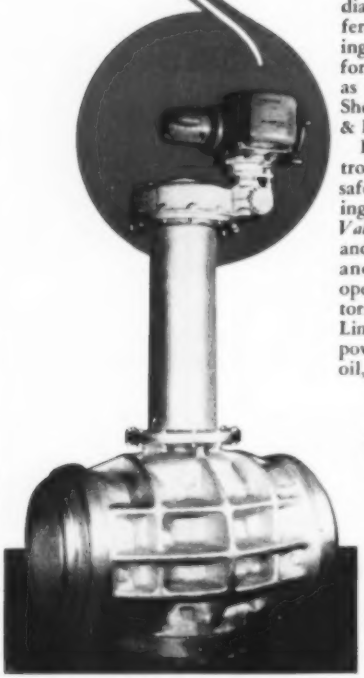
Remote Control OF PLUG VALVES, TOO...

by LIMITORQUE

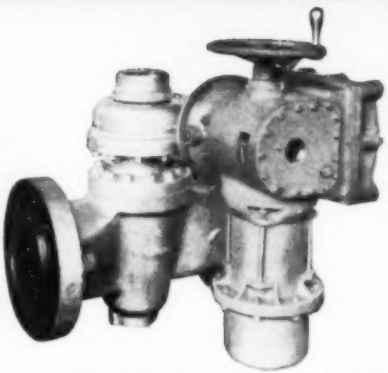
"PUSH-BUTTON" VALVE OPERATORS

Plug Valves up to 30" diameter, 1000 p.s.i. differential pressure, operating day-in and day-out, for such well-known firms as Texas Pipe Line Co.; Shell Oil Co.; Pacific Gas & Electric Co., etc.

For remote or local control . . . positive, speedy, safe and dependable opening and closing of *Plug Valves*,—also Gate, Globe and Butterfly Valves,—and for automatically operating: doors, ventilators, damper controls, etc. LimiTorque utilizes any power source: electricity, oil, gas, water or air.

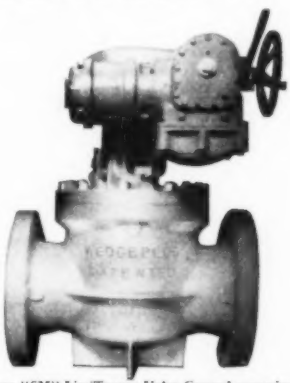


A Type "SM" LimiTorque Motor-operated Valve Control operating a 24", 1000 lb. Nordstrom Plug Valve, through double reduction gear box.



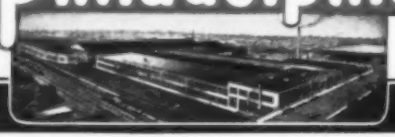
A Type "SM" LimiTorque Motor-Operated Valve Control operating on 8" Walworth Plug Valve.

Be convinced, send for our 96 page "LimiTorque" Valve Catalog . . . it's a "veritable treatise" on *motorized valve operation*. Please use your Business Letterhead when requesting your copy.



Type "SM" LimiTorque Valve Control operating 8", 600 lb. "Wedgeplug" Valve.

Philadelphia Gear Works, INC.



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IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

weight, and ferulok flareless. Dimensions are tabulated for the entire size range. Also discussed are flaring tools, hand and production tube benders, tube cutters and other accessories.

For a copy write The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio, referring by number to this PETROLEUM REFINER item.

Gas Cutting Machine (Item 565)

The oxygraph and the travograph, both manufactured by Air Reduction Sales Company are described in folder Form No. ADC 628C which includes the field of application of the machines, features of each machine, and descriptions of the machines at work on typical jobs.

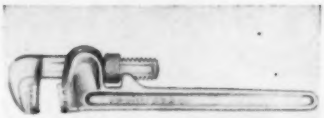
For a copy write Air Reduction Sales Company, 60 East 42nd Street, New York 17, referring by number to this PETROLEUM REFINER item.

Pressure Recorder (Item 566)

Bulletin No. G620 on The Bristol Company's absolute pressure gauges describes the instrument and gives data on the priciple of operation which makes it possible to record and control absolute pressure within a scale range as low as zero to 20 millimeters of mercury absolute. Known as the series 500, the instrument is offered as an automatic controller, recorder and remote measurer and has a pressure-sealed lever arm which is frictionless, free from lost motion and free of turning moments due to changes in differential pressure across it.

For a copy write the Bristol Company, Waterbury 91, Conn., referring by number to this PETROLEUM REFINER item.

Aluminum Wrench (Item 567)



J. H. Williams & Company has developed satin-finish aluminum pipe wrenches with replaceable, interchangeable alloy steel jaw inserts which are cadmium plated. The same insert fits handle or movable jaw which is suspended between two springs. Multiple dove-tail design and retaining screw assure easy assembly and firm anchorage. Steel adjusting is case-hardened, knurled and cadmium-plated.

For further information write J. H. Williams & Company, 400 Vulcan Street, Buffalo 7, N. Y., referring by number to this PETROLEUM REFINER item.

Steam Generator (Item 568)

Steam generators described in Cyclotherm Corporation's Bulletin P-1 have a high atomizing burner nozzle incorporating a primary air supply for injection of fuel and air for high combustion at all firing rates. The design permits interchangeable oil or gas firing without a change of nozzle, which combined with the cyclonic combustion principle maintains high combustion efficiency with either fuel. Also included are a simplified air supply system, improved combustion and ignition programming controls, and a blower-air channel design that achieves quiet operation. It is available in sizes ranging from 10 to 300 h.p. and in pressure from 15 to 200 pounds.

For a copy write Cyclotherm Corporation, Department 170-R, 90 Broad Street, New York 4, referring by number to this PETROLEUM REFINER item.

Metallizing Gun (Item 569)

Wall Colmonoy Corporation's new catalog describes the Colmonoy spraywelder (a powder metallizing gun) and the sprayweld process. Also listed are applications and advantages of the process, the properties used, the limitations, and the equipment and facilities needed. The spraying of powdered Colmonoy Nos. 6, 5 and 4 and powdered metals such as brass, copper, and zinc, is explained to show how the gun can be used for metallizing as well as for the regular process which combines both welding and metallizing.

For a copy write Wall Colmonoy Corporation, 19345 John R Street, Detroit 3, referring by number to this PETROLEUM REFINER item.

Abrasive Resistance (Item 570)

A bulletin of the Electro-Alloys Division of American Brake Shoe Company describes the physical properties of Thermalloy HC-250, lists uses, applications and advantages. It describes case histories of the metal, giving actual field service data in each case. Physical properties of the material are compared with

Out of the Clark
RESEARCH LABORATORIES
comes the
BIGGEST STEAM TRAP NEWS
in 50 years!
Clark DUO-STEP Leverage
Duo-Step Leverage — can save thousands of dollars annually for steam trap users ... in lower initial cost and greater drainage efficiency.
DUO-STEP LEVERAGE NOW AVAILABLE IN THESE CLARK STEAM TRAPS
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INCREASES TRAP DRAINAGE CAPACITY OVER 100%
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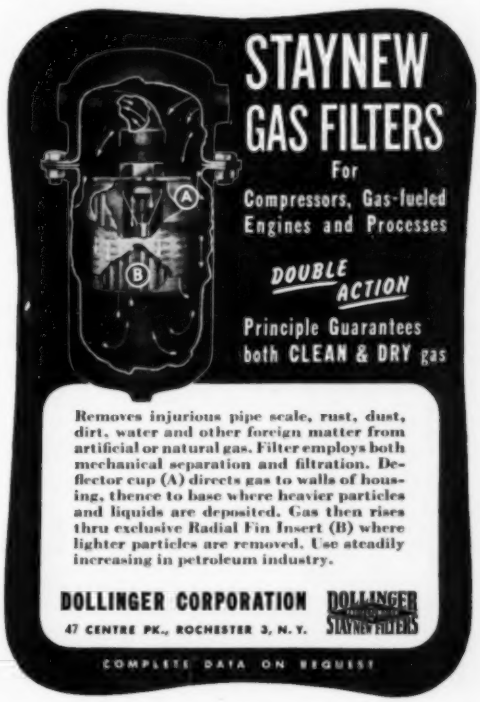
STEAM TRAPS AND FLUID CONTROLS
THE CLARK MANUFACTURING CO. • 1830 E. 38th St. • CLEVELAND 14, OHIO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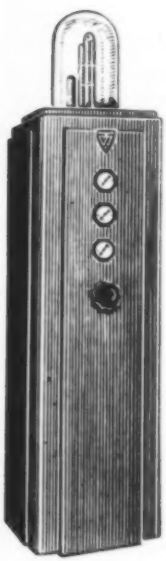
For Compressors, Gas-fueled Engines and Processes
DOUBLE ACTION
Principle Guarantees both CLEAN & DRY gas
A
B
Removes injurious pipe scale, rust, dust, dirt, water and other foreign matter from artificial or natural gas. Filter employs both mechanical separation and filtration. Deflector cup (A) directs gas to walls of housing, thence to base where heavier particles and liquids are deposited. Gas then rises thru exclusive Radial Fin Insert (B) where lighter particles are removed. Use steadily increasing in petroleum industry.
DOLLINGER CORPORATION
47 CENTRE PK., ROCHESTER 3, N. Y.
DOLLINGER STAYNEW FILTERS
COMPLETE DATA ON REQUEST

APARTMENT FOR SLIME

With condenser tubes handling unchlorinated water, slime-forming bacteria never have to worry about a housing shortage. Instead, these bacteria move in, form their colonies, and the condenser tubes become apartments for slime. When this happens, the terminal log mean temperature difference rises, excess steam costs go up, and outage increases along with the labor bill for costly plug cleaning.

Chlorination, engineered by W&T and backed by 35 years' experience, has proven itself the effective answer to slime in condenser and heat exchanging equipment. It is effective because the Wallace & Tiernan De-Sliming Process attacks the cause of slime, bacteria, and "evicts" these unwanted "tenants" from their home in your equipment.



CD-32

Regardless of whether yours is an open or closed cooling system or whether you use shell and tube, trombone, or open box condensers, Wallace & Tiernan engineering plus time-tested W&T Chlorinators can put all the money-saving advantages of slime control by chlorination to work on your condensers or heat exchange equipment.

Write today for complete information.

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

13 precent manganese steel, ABK metal (controlled Ni-Hard) and white cast iron.

For a copy write American Brake Shoe Company, 230 Park Avenue, New York 17, referring by number to this PETROLEUM REFINER item.

Service Directory (Item 571)

The Lincoln Electric Company has published a service directory of all its authorized field welding service shops. Through its field shops the company has repair, rental and preventive services for Lincoln Welding Machines as well as stocks of parts.

For a copy of the directory write The Lincoln Electric Company, Cleveland 1, Ohio, referring by number to this PETROLEUM REFINER item.

Manual Starter (Item 572)

The Trumbull Electric Manufacturing Company, in Circular TEC-317A, describes the TT manual starter which provides overload protection for small motors up to one hp. Maximum voltage rating of the starter is 230 volt a.c., 250 volt d.c., single or double pole. Interchangeable heaters, which are coils of resistance wire selected to suit the current ratings of the motor with which they are used, react on a thermostat, interrupting the circuit and preventing damage to the wiring. Applications, box dimensions and specifications are included in the circular.

For a copy write The Trumbull Electric Manufacturing Company, Plainville, Conn., referring by number to the PETROLEUM REFINER item.

Spray Nozzles (Item 573)

A spray nozzle for special use where a fine break-up at low pressures is required has been manufactured by Bete Fog Nozzle Company of Channing L. Bete Company, Inc. The nozzle is produced in various spray patterns with flow rates ranging from one-quarter to 100 gallons per minute. The spiral design does not require vanes or whirl discs.

For further information write Channing L. Bete Company, Inc., 20 Federal Street, Greenfield, Mass., referring by number to this PETROLEUM REFINER item.

Silicone Grease (Item 574)

Silicone greases as ball bearing lubricants are described in two publications of Dow Corning Corporation. Silicone Notes No. D-5, "Dow Corning Silicone Greases" gives the properties, performance and uses of heat stable and oxidation resistant silicone lubricants. High temperature stability is demonstrated in a table of bleed and evaporation values for these greases and other high temperature petroleum greases. Silicone Notes No. D-6 contains information on "How to Use DC 44 Silicone Grease in the Bearings of Electric Motors" and includes instructions for lubricating open and single shielded ball bearings and relubrication schedules based on the experience in developing and testing silicone grease.

For a copy of either of the two publications write Dow Corning Corporation, Midland, Mich., referring by number to this PETROLEUM REFINER item.

Masonry Saw (Item 575)

"Valor," a new portable, light-weight (225-pound) masonry saw of Victor Engineering Corporation of Bristol, Pa. features an automatic blade pressure control to eliminate guesswork. The 1½-h.p. motor drives both water pump and blade to make an efficient dry and wet cutting device. An instant head-removal, built-in foot pedal arrangement, dual foot pedal springs, wobble-proof cart, a trouble free self-priming pump, and cadmium plated parts are included in its construction with tube and ¼-inch angle combined.

For further information write Victor Engineering Corporation, Bristol, Pa., referring by number to this PETROLEUM REFINER item.

Fluxes (Item 576)

Victor Equipment Company announces the development of four new fluxes: Victor No. 3 flux for brazing brass and bronze, steel, clean cast and malleable iron; Victor No. 5 flux for moderate heat brazing of cast and malleable iron; Victor No. 7 flux for high heat brazing of cast and malleable iron

Specializing In
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Unloading and Hauling, Preparing to Erect 65 Ton "Bubble Tower"

A Complete Organization Serving the Major Industries
Throughout the Southwest for 66 Years.
EXPORT CRATING FOR FOREIGN SHIPMENTS

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RIGGING & HEAVY HAULING CO., INC.
117 EASTWOOD – HOUSTON, TEXAS

THERMOWELLS
Standard Test Wells

Type T-190 Series TRINITY Standard Test Well

T-190 — 1" SPT-7/16" bore for etched stem, bi-metal test, or armor clad thermometers, or any primary element with diameter not over 0.427".

T-191 — 3/4" SPT — 7/16" bore for same.
T-192 — 1/2" SPT — 7/16" " " "

Sizes: 2", 4", 6", 8", 10", 12", 15" and 18" immersion length. Special orders up to 36" (T-190 and T-191 only).

Wall thickness: 0.219" (T-190); 0.187" (T-191); 0.094" (T-192).

Lagging extension available.
Plug & Chain regularly furnished.

* * *

TRINITY manufactures all types of metal protecting wells for the primary detecting elements of all types of temperature indicating, recording and controlling instruments for a wide range of industrial applications

SEND FOR your copy of new illustrated TRINITY catalog.

TRINITY EQUIPMENT CORPORATION
498 Westfield Ave. East, Roselle Park, N. J.
THERMOWELLS and Other Specialties for the Process Industries

where base metal gets exceptionally hot, and Victor No. 9 flux for fast, effective welding of cast iron.

The manufacturer claims these new fluxes clean parent and filler metal, cling to the heated rod, do not blow off, leave finished braze clean, contain no toxic ingredients, and "tin" burned spots in cast iron brazing.

For detailed information write Victor Equipment Company, 844 Folsom Street, San Francisco 7, referring by number to this PETROLEUM REFINER item.

Power Wheelbarrow (Item 577)

Moto-Bug, the new power wheelbarrow of Kwik-Mix Company, described in a catalog, is designed for construction and industrial work. Schematic diagrams and engineering specifications are listed in addition to a summary of Moto-Bug's design and performance. Powered by a standard 4-hp. gasoline engine, it travels both forward and reverse at 2-4 miles per hour. The hopper capacity is 10 cubic feet or 1200 pounds on platform body.

For a copy of the catalog write Kwik-Mix Company, Port Washington, Wis., referring by number to this PETROLEUM REFINER item.

Welding Accessories (Item 578)

Descriptions of more than 150 arc welding accessories are contained in General Electric Company's Bulletin GEC-253A. Included are electrode holders, helmets and goggles, tungsten electrodes, protective aids and clothing, electrode carriers, cable connectors, ground clamps, brushes, cleaning tools, and the fillet weld gage. Products shown "will meet the requirements of ordinary welding work, as well as other special applications."

For a copy write General Electric Company, Schenectady 5, N. Y., referring by number to this PETROLEUM REFINER item.

Magnetic Motor Control (Item 579)

Claimed to give full protection against damage from overload and undervoltage to A-C motors up to 50 hp, the new line of magnetic motor control by The Trumbull Electric Manufacturing Company is described in Bulletin TEB 8. It presents data and illustrations on types of disconnects, reversing starters, non-reversing starters, reversing contactors, non-reversing contactors and combination magnetic starters. Relay heaters are also included.

For a copy of the bulletin write The Trumbull Electric Manufacturing Company, Plainville, Ohio, referring by number to this PETROLEUM REFINER item.

Power Cranes (Item 580)

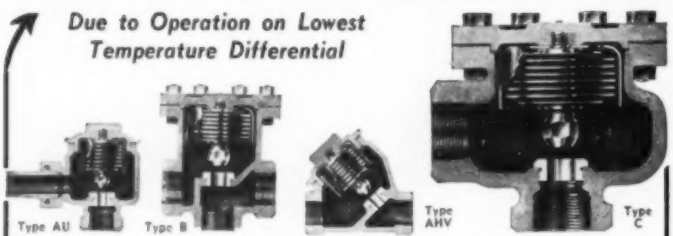
A new folder of The Thew Shovel Company describes rubber tire motocranes, self-propelled Lorains and crawler machines. It also shows how power cranes and shovels can cut costs in the petroleum industry. Five types of booms are explained that are interchangeable on Lorains.

For further information write The Thew Shovel Company, Lorain, Ohio, referring by number to this PETROLEUM REFINER item.

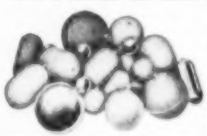
Nicholson Steam Traps

STOP WATERLOG LOSS

Due to Operation on Lowest Temperature Differential



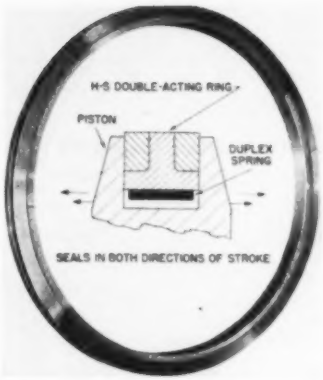
Repeated comparative tests by large trap users show that Nicholson traps operate on lowest temperature differential: 5° to 15°, depending on trap size and steam pressure. Production of cooking kettles, for example, has been increased as much as 30% because fast action of Nicholson traps keeps equipment full of live steam. They are specified for all apparatus where back-up of condensate causes corrosion or damage to thin gauges. 5 types for every application; size ¼" to 2"; pressure to 225 lbs.



HIGH-PRESSURE FLOATS — Stainless, monel, steel or plated steel. Welded. In all sizes and shapes; for operating mechanisms and as tanks or vessels. 2-day delivery. BULLETIN 348.

BULLETIN 1047 or Refinery Catalog

W. H. NICHOLSON & CO., 207 Oregon St., Wilkes-Barre, Pa.



Piston Ring (Item 581)

Hunt-Spiller Manufacturing Corporation has offered a new three-piece piston ring for steam operated air pumps, pumps of various types, steam and air cylinders of stationary air compressors, and in air cylinders of electrically driven air compressors. Each piece is cut into segments and the segments are dowelled in position so that the gaps between them cannot align. These double acting rings are made in sizes and widths for all replacement installations.

For a copy write Hunt-Spiller Manufacturing Corporation, 383 Dorchester Avenue, South Boston 27, referring by number to this PETROLEUM REFINER item.

Variable Speed Drive (Item 582)

"Adjusto-Spede," an alternating current motor having adjustable speed, described in Bulletin 611-D of The Louis Allis Company, operates directly from a 2 or 3-phase a.c. line with a constant torque characteristic through an eddy current principle without the motor generator set or exciter. The drive is suited for calenders, printing presses, paper and metal slitters and conveyors. "Continuous duty speed ranges as high as ten to one are possible in the smaller sizes. Intermittent duty speed range is infinite in all sizes." Photographs illustrate applications and each of the machine's parts.

For a copy write The Louis Allis Company, Milwaukee 7, Wis., referring by number to this PETROLEUM REFINER item.

Safety Valve (Item 583)

"New efficiency" in the operation of safety and relief valves handling viscous materials is made possible by an internal heat exchanger design developed by Farris Engineering Corporation. The heater is a steam coil built into a valve body around the seat and guide. Heat is provided so as to keep highly viscous materials in a fluid state. Need for steam tracing is said to be eliminated. The heat exchanger is available in all the company's safety and relief valves.

For further information write Farris Engineering Corporation, Palisades Park, N. J., or O. S. Tyson and Company, Inc., New York Central Building, 230 Park Avenue, New York 17, referring by number to this PETROLEUM REFINER item.

ARCOS

ELECTRODES PAY THEIR WAY...

TAKE ADVANTAGE OF THESE VALUABLE ARCOS SERVICES

Laboratory Research

Quality Control

Field Service

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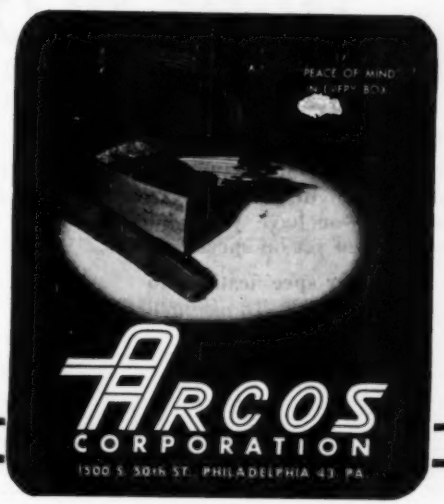
Technical Information

In our long association with stainless fabricators, we have learned that their first and last interest in electrodes is the production of sound weld metal. Arc characteristics, ease of slag removal, bead appearance are all plus qualities easily evaluated but sound welds *on every job* and *from every pound of electrodes* is vital to the user's reputation.

We have further learned, as manufacturers, that stainless electrodes of a quality which will produce sound weld metal *all the time* are achieved only through a considerable expenditure of technical skill in testing and retesting. Arcos electrodes which do not produce trouble-free welds under our strict quality control tests are rejected *before they reach our warehouse.* This extensive care to produce trouble-free electrodes is reflected in the price of Arcos electrodes.

The extensive care in the Arcos processing of electrodes costs more than conventional methods used in the manufacture of low priced steel electrodes but it pays out when it eliminates the costs of chipping and rewelding or failure in service.

The best informed buyers of stainless electrodes specify Arcos.



ELECTRODES • COILED WIRE • BARE ROD

Visit the Arcos Booth #1125 at the Metal Show.

About EQUIPMENT and SERVICE Suppliers

Gordon Z. Greene Company Expands Representation

Gordon Z. Greene, west coast oil and gas specialist, has announced the expansion of Gordon Z. Greene Company in organization and interests. The firm, of which he is president, is now exclusive distributor in California for Commercial Iron Works of Los Angeles, manufacturer of leveling saddles, and orifice fittings, including orifice flanges and meter plates. It is also Pacific Coast agent for the following companies: Vulcan Proofing Company of Brooklyn, which specializes in rubber coated materials for meter and regulator diaphragms; Chaplin-Fulton Manufacturing Company of Pittsburgh, makers of high and low pressure regulators and relief valves; and Research Control Instrument Company of Tulsa, designers and manufacturers of miniature control valves and panel-board clocks.

Greene

Midvale Makes Sales Changes

The Midvale Company, Philadelphia, has announced changes in its sales organization and personnel as follow: H. C. Lackey appointed district sales manager at Chicago with jurisdiction over the St. Louis and Houston districts; J. R. Steele appointed representative in St. Louis; W. L. Van Winkle appointed representative in Houston; A. R. Gaus, district sales manager, Pittsburgh, given extended jurisdiction to cover the Cleveland district, to be assisted by J. W. Baer and F. N. Satter; A. Richter, former salesman in the New York district, transferred to Washington, D. C.

Also an office has been opened in Boston with Herman Bergholtz continuing as representative.

When PRECISION is the word

JELLIFF HAS A MESH FOR IT

particularly in the finer weaves, where hole size is vital to a delicate process.

WIRE CLOTH

HAS LONG BEEN PREFERRED FOR ITS EXTREME ACCURACY and UNIFORMITY

Meshes—as fine as 200 x 200—50 x 750 . . .

Materials—any ductile metal inert to your process . . .

Weaves—Straight, Twilled, Dutch-Twilled; crimped, calendered—or have you something new? We haven't been stumped yet on special orders.

Just send your specifications to *Department 16*

THE C. O. JELLIFF MFG. CORP.

DIPPING BASKETS
LEKTROMESH
RESISTANCE WIRE

WIRE MESH PARTS
WIRE CLOTH
STRAINERS + FILTERS

SOUTHPORT CONNECTICUT

Elliott Company Appoints Agent and Vice President

Elliott Company has appointed J. A. Wilson representative in Dallas for the Fort Worth, Dallas and East-West areas and has named Charles A. Butcher a vice president of the company. Butcher will continue to function as a general manager of the Crocker-Wheeler Electric Manufacturing Company, recently acquired by Elliott Company. Wilson will operate from his Dallas headquarters as

Butcher

Wilson

a resident field engineer of the Tulsa district headquarters.

He received a bachelor of science degree in mechanical engineering from the University of Oklahoma in 1941. He worked five years with Champlin Refining Company before joining Elliott Company in 1945 as a field engineer.

Butcher received his B.S. and E.E. degrees from Iowa State College and has had more than 30 years of experience in phases of the electrical field.

With the addition of the Crocker-Wheeler Division, one of the pioneers in the manufacture of electrical machinery, Elliott Company now has a complete line of a.c. and d.c. motors ranging in size from one to 25,000 hp. Formerly Elliott Company's line of equipment did not include motors under 200 hp.

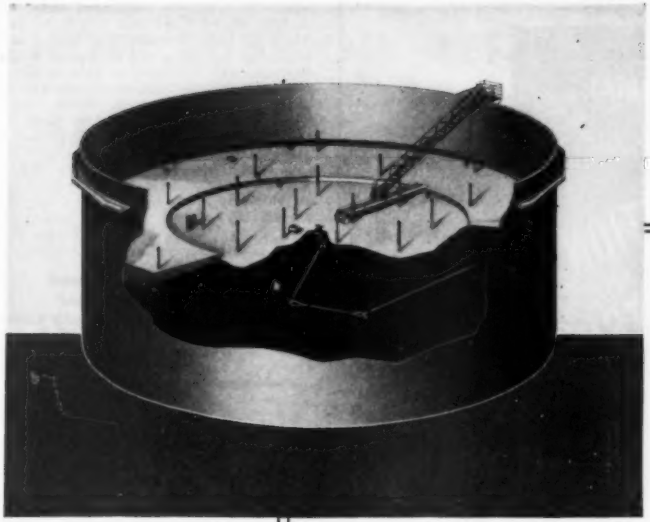
Becomes General Manager

David H. Jackson, vice president of Croll-Reynolds Company, Inc., manufacturers of steam jet vacuum equipment, has been named general manager. Jackson, who joined the firm in 1930 as sales manager, was made vice president in 1937. A graduate chemical engineer from The University of North Carolina, he is a member of AICE, the Chemists' Club, the Salesmen's Association of the American Chemical Industry, the American Chemical Society, the Society of Chemical Industry, the American Oil Chemists Society and is a fellow in the American Institute of Chemists.

Jackson

Kieley & Mueller Name Three New Sales Agents

Kieley & Mueller, Inc., has appointed three new sales representatives to handle distribution of the firms' industrial control valves from the Southwest to Oregon. W. J. Beckett Company will



the HORTON PONTOON Floating Roof

Another Horton Design for protecting volatile hydrocarbons

The Horton PONTOON Floating Roof is used on flat-bottom storage tanks to protect crude oil, gasoline, and other volatile hydrocarbons from evaporation loss. It floats directly on the surface of the liquid in the tank. The elimination of the vapor space does more than stop "breathing" and "filling" losses. It also reduces corrosion on the underside of the roof and does away with the combustible vapors that could cause a fire. Furthermore, the PONTOON design cuts down evaporation losses caused by "boiling" because the air space in the pontoon section serves as an effective insulating medium for over half of the area of the tank.

The economical design, the effective product protection, and the safe operation that you get with the PONTOON Roof make it very desirable for use on petroleum refinery installations. This roof is especially recommended for tanks that are filled and emptied frequently, tanks in blending service, tanks storing corrosive products, and tanks located in congested areas.

OTHER TYPES

- **the Horton DOUBLE-DECK Floating Roof**—which can be used with a wide range of volatile hydrocarbons, because it provides insulation for the entire surface of the liquid in the tank.
- **the Horton PAN-TYPE Floating Roof**—which is normally installed on tanks handling heavier petroleum products where "boiling" losses are not an important factor.

All three types are equipped with the Improved Horton Seal — *the most effective device developed to prevent the escape of vapor around the edge of a floating roof.*

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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta 3	2146 Healey Building	Detroit 26	1520 Lafayette Building	Philadelphia 3	1608—1700 Walnut Street Building
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Boston 10	1030—201 Devonshire Street	Houston 2	2126 National Standard Building	San Francisco 11	1251—22 Battery Street Building
Chicago 4	2463 McCormick Building	Los Angeles 14	1534 General Petroleum Building	Seattle 1	1331 Henry Building
Cleveland 15	2234 Guildhall Building	New York 6	3302—165 Broadway Building	Tulsa 3	1626 Hunt Building

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Awaiting you at this great Chemical Industries Exposition, will be more informative exhibits and demonstrations, more cost-saving ideas, more new developments, more practical answers to production problems . . . than you've ever seen assembled in one place expresly for the chemical processing industries. Plan now to see and learn about the latest developments in methods, materials, and equipment for better, faster, and less costly process operations in the oil processing industry.

You can get a wealth of valuable information that will help to place your plant in a better position to meet growing competition through lower costs and better products. Be sure to be there.

Management International Exposition Co.

6770

represent southern California sales including all of California south of and including Inyo, Fresno, San Benito and Monterey counties and Arizona. Hugh Rodman will handle that area north of and including the California counties of Mono, Madera, Merced, Santa Clara, Santa Cruz. In Nevada this territory includes Mineral, Lyon, Douglas, Ormsby, Storey and Washoe counties. The West Coast section will be covered by Franes & Martig, Inc., and includes Oregon and Washington and west of the eastern boundaries of the Idaho counties of Clearwater, Boise, Bonner, Idaho, Elmore, Shoshone, Valley and Owyhee.

Dr. Paul Bachman Is Named Davison Chemical Manager

Dr. Paul W. Bachman has been named manager of the newly formed department of development planning of The Davison Chemical Corporation. He will act as liaison between the research, operations and marketing divisions to prepare for the introduction of new, improved products, services and processes for the industry.

Bachman received his degree in chemical engineering and his doctor of philosophy from Johns Hopkins University in 1926. He was previously employed with E. I. duPont de Nemours Company, General Chemical, The Victor Chemical Works and Chemical Solvents.

Victor Equipment Company Now Manufacturing Gas Regulators

Victor Equipment Company has begun the manufacture of corrosion-resistant regulators for the precision control of wet and dry gases. A producer of gas welding equipment for over thirty years,

Pump Packing Troubles

may mean costly shutdowns. Packing troubles ALWAYS mean higher operating costs. Have you tried Centrifugal Pumps which require NO packing? Most satisfactory for pumping acid and other corrosive liquids.

Descriptive Bulletin on Request

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Trays and Bubble Caps Cleaned at 1/10 Old Cost . . . says Refiner

REMOVING carbonized and gummy deposits and sludge from the trays and bubble caps of a 44 ft. x 3 ft. diameter, 26-tray stabilizing tower was estimated by one refiner to cost near $1,000. But when the job was handled the Oakite way . . . by circulating a hot Oakite detergent solution . . . the cleaning job was completed at less than one-tenth this estimated cost. And the tower was put back into service faster.

Get procedural data on this and other Oakite cleaning methods and materials designed for the Petroleum Industry—FREE. Just contact your local Oakite Technical Service Representative. Oakite Products, Inc., 50B Thames St., New York 6, N. Y.

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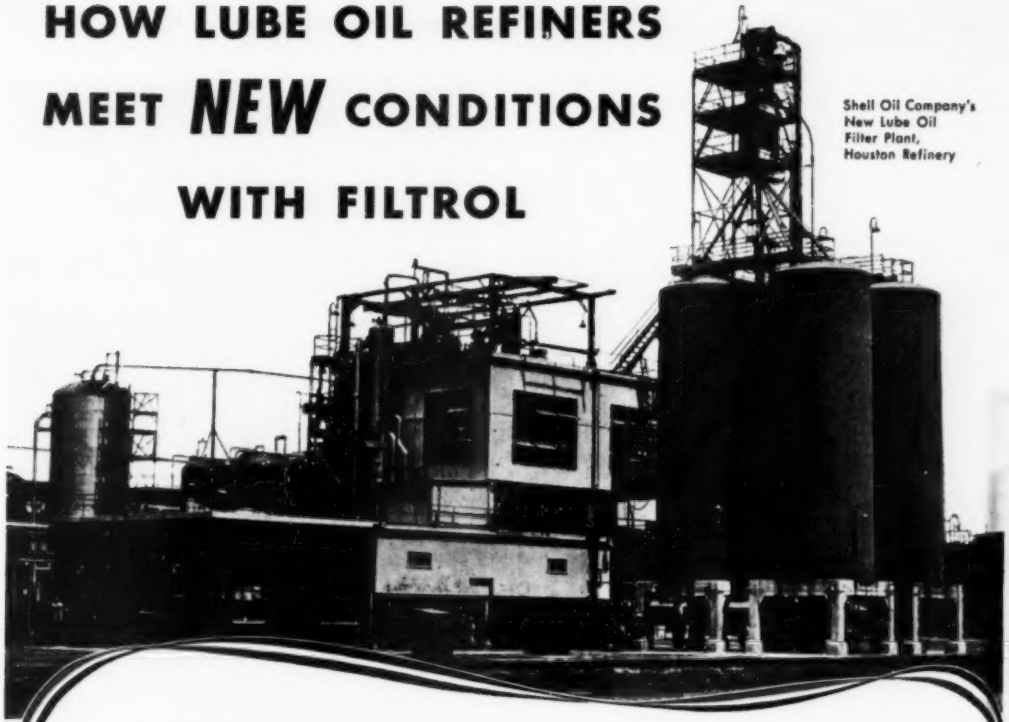
SPECIALIZED INDUSTRIAL CLEANING

MATERIALS • METHODS • SERVICE

HOW LUBE OIL REFINERS MEET *NEW* CONDITIONS WITH FILTROL



Shell Oil Company's New Lube Oil Filter Plant, Houston Refinery

Changing Times MAKE NEW DEMANDS ON PRODUCT, PROCESS AND PRODUCTION...AND FILTROL CAN HELP FULFILL THESE DEMANDS—

1. For Product *QUALITY...*

Filtrol has the uniformity and controlled high adsorptive power that produces top specification oils – with the "bloom" that spells quality to the buyers' eyes.

2. For Processing *VOLUME...*

Filtrol contact finishing is economical, because with this fully activated adsorbent, less clay is needed per barrel of charging stock, with consequent higher production efficiency of processing equipment.

3. For Production *SAVINGS...*

Many savings accrue to Filtrol users – smaller tonnages of adsorbent mean less freight charges – less storage volume necessary – less filtering capacity required – less spent cake means fewer barrels of oil lost by retention and resultant lower handling and disposal costs – fewer hands are needed for full production.

This modern Shell lube plant in Houston is already meeting new conditions with Filtrol. Here, extensive use of the most modern mechanical devices and controls makes processing to specification test virtually automatic. Savings are effected through better control and process improvement. Inexpensive air lift transfers Filtrol adsorbent from car to supply bins; automatic equipment measures the clay into the oil; change-overs, operated on accurate time-controls, greatly reduce off specification product. Air-conditioning in the control rooms aids operation through improved working conditions.

Technical information sent on request.

FILTROL CORPORATION

General Offices: 634 S. Spring St.
Los Angeles 14, Calif.
Plants: Vernon, California and Jackson, Mississippi

Filtrol* **ADSORBENTS CATALYSTS**

*T.M. Reg. U.S. Pat. Off.

Filtrol products are available throughout the world

WORLD'S LARGEST QUALITY MANUFACTURER OF CATALYSTS, ADSORBENTS AND DESSICANTS

the company is now offering regulators to handle corrosive gases such as wet chlorine, wet sulfur dioxide, wet hydrogen sulfide, wet ammonia and wet boron trifluoride.

Required corrosion-resistance can be developed into any of the company's assortment of standard regulators. Included features are delivery pressures up to 5000 psi., gas volumes up to 2000 cfm., remote control, and precision regulators. Large volume, self-seating relief valves can be supplied to function at any pressure from 1 psi. to 2000 psi.

Union Malleable to Expand

Union Malleable Manufacturing Company, at its annual sales conference held September 12-13 in Ashland, Ohio, announced plans to expand its Ashland, Ohio, plant and to add new products and sizes to the "U" brand line. Jack Jacobson, president, said that the recent modernization program completed in June was just a step in the company's expansion plans. He said the company also plans a new packaging program which will deliver the products, in addition to bulk shipments, "in convenient packages for ease of sales and storage."

Flexitallic Distributors

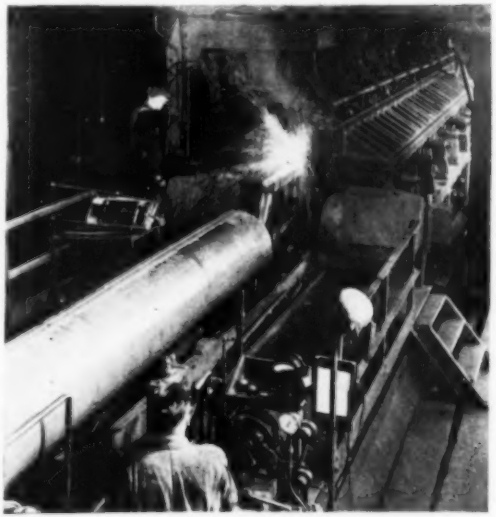
Flexitallic Gasket Company, Camden, N. J., has appointed Tube Engineering and Service Company, Montreal, Can., as distributor for all Canadian provinces east of Manitoba; Power Engineering and Equipment Company, Inc., Wilmington, Calif., distributor for southern California, including San Luis Obispo, Kern and San Bernadino counties; and Transmission Engineering Company, San Francisco, a distributor for northern California.

A. O. Smith Announces Houston Plant

A. O. Smith Corporation of Milwaukee, Wis., has formed a company, A. O. Smith Corporation of Texas, which will build and operate a $5 million plant in Houston for the manufacturing of welded steel pipe both for gas and oil transmission lines and for oil well casing. The capital stock of the new company will be held by A. O. Smith Corporation and the Sheffield Steel Corporation. Construction is expected to start at once.

The plant is scheduled to be in operation by the summer of 1950. It will have a capacity of from 30,000 to 35,000 tons of pipe per month and will be the second largest mill in the country for the production of welded pipe.

The new plant, which will be located on Industrial Road in the Greens Bayou area, adjacent to the present Houston works of A. O. Smith Corporation, will in no way affect the latter's present operations. The company also maintains a district administrative office in Houston that handles the sale of all A. O. Smith products in eight southwestern states.



Pipe Fabricating Facilities in A. O. Smith Milwaukee Plant.

1965 STAINLESS STOCK ITEMS in FLOWLINE TRADE MARK

Stainless Steel Welding Fittings

The most complete line ever offered—available in three Stainless Types (304, 316, 347) to match pipe and tubing of various wall thicknesses in sizes from ⅛" through 12"; in all standard fittings illustrated. Special fittings, and other analyses, can be supplied on special order.

All FLOWLINE fittings are made of forged or rolled stock; annealed, cleaned, and passivated for maximum corrosion resistance. Their use makes possible fabrication of every type of stainless piping system with minimum equipment simply by straight cutting of tubes to desired lengths, and plain butt welding.

The most complete line of Stainless Steel Welding Fittings

Send for Bulletin S-310

WELDING FITTINGS CORP.

NEW CASTLE, PENNSYLVANIA

Formerly Stainless Alloy Division - Pittsburgh Piping and Equipment Co.

World's Largest Manufacturer of Stainless Steel Welding Fittings

ELEMENTS OF DIESEL ENGINEERING

By ORVILLE L. ADAMS

Publication of the long-awaited second edition of ELEMENTS OF DIESEL ENGINEERING, a completely rewritten and revised book based on Orville L. Adams' previous work of the same name which was INDUSTRY-TESTED, PROFESSIONALLY ACCEPTED, and USED AS A TEXT IN SCHOOLS THE WORLD OVER, is now completed.

Here you will find explained the principles and practices of Diesel Engineering—Diesels as they are worked, not as theorized.

FUNDAMENTALS are clearly presented in logical, step-by-step manner, with no confusing language. The author, as a Naval Officer in charge of Diesels during the war, taught classes of Army and Navy personnel. This teaching experience, added to his former work as a Diesel research engineer, and widely-known writer on Diesels, proved invaluable to Mr. Adams in the preparation of this great new book.

The man who knows little, even the man who knows NOTHING of Diesel Engineering will find in these pages all that he needs to learn to qualify as a skilled Diesel man. Engineering standards, and the attitude of the Diesel industry are accurately presented. INSTRUCTORS in technical schools and colleges will find in this book an old friend—a text many of them found to be indispensable in their classes before the war, a book that stands on its own feet in a way many texts fail. The PROBLEMS, the QUESTIONS AND ANSWERS after each chapter are especially designed to help the class room teaching of this important field of engineering.

THE AUTHOR, Orville L. Adams, is widely-known in the publishing as well as the academic fields, and to an extent seldom found in one man, he combines practical experience with an intimate knowledge of the requirements of the school and college. ELEMENTS OF DIESEL ENGINEERING, as it appears in this new edition, could have been written only by an engineer, turned instructor, with sound experience in the preparation of books

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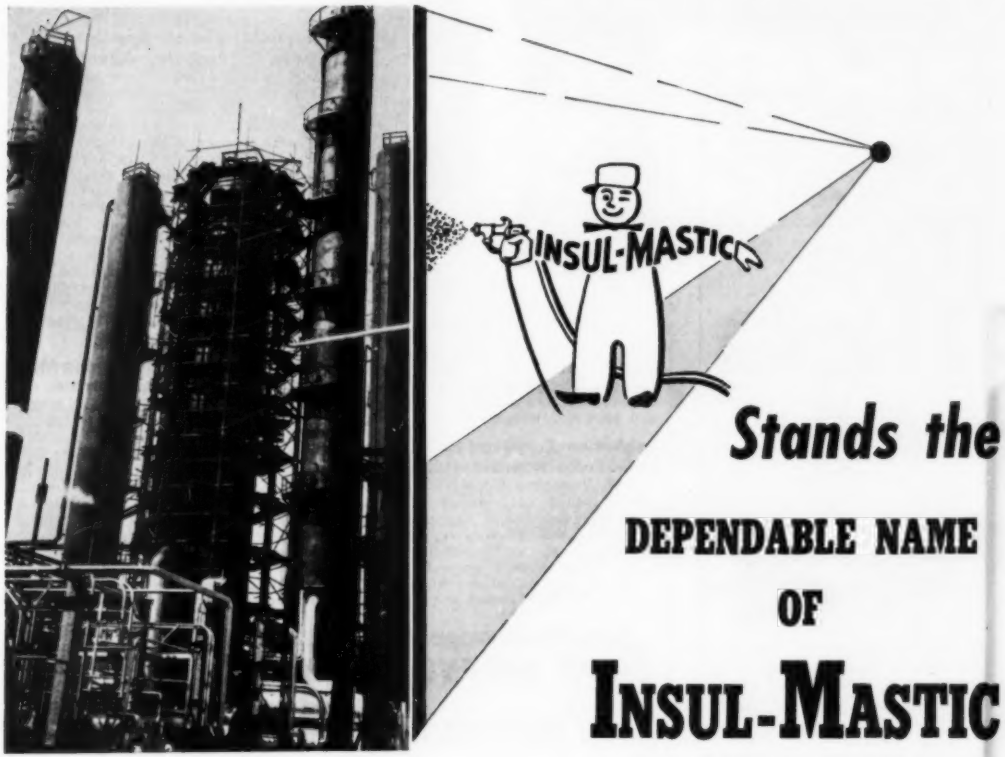
Behind This Coating Application



Stands the DEPENDABLE NAME OF INSUL-MASTIC

Insul-Mastic coatings have been tested in many industries and found to exceed by far the standards to which their coating specifications had to be limited in the past. The verdict of these industries has been "Exceptional durability plus acid, alkali and moisture resistance exceeding all expectations."

The outstanding quality of Insul-Mastic coatings is due to a completely different type formula. This includes the use of large percentages of such quality ingredients as Gilsonite and mica. Many imitators employ only token amounts of these materials—just enough to mention them.

Insul-Mastic coatings have four basic uses:

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- **PREVENTING CORROSION**—Coated steel, submerged in acid solutions has not been harmed.
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End your coating problems and reduce maintenance costs. *Think first of the coating that lasts.* Write to Insul-Mastic Department 1 at the address below and see our insert in Sweet's Catalog.

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OLIVER BUILDING • PITTSBURGH 22, PENNSYLVANIA

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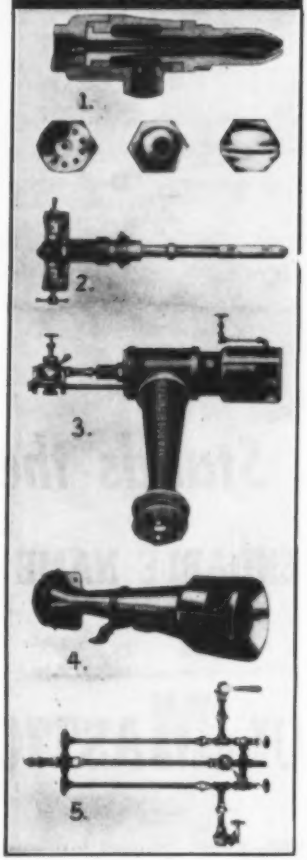

1. TYPE "S-A"
(For use where steam is available) *atomizes thoroughly* and *burns completely*, the lowest and cheapest grades of fuel oil and tar, requiring only low oil pressure and temperatures.

2. TYPE "S-A-L"
(Large capacity burner similar to TYPE "S-A-R") is adaptable in combination with powdered coal burners in large boilers.

3. COMBINATION GAS AND OIL BURNER
—the "AIROCOOL" Gas Burner in combination with a TYPE "S-A-R" Oil Burner.

4. "AIROCOOL" GAS BURNER
(Of venturi type) assures low turndown without burnback.

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(Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatum, organic oil residuums, waste cutting oils, sulphite pulp liquors, etc.

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Glitsch Appoints Two Managers

Fritz W. Glitsch & Sons, Inc., has announced the promotion of Robert L. Allen as district manager at Cleveland and Allan Persson as manager of the

Allen

Persson

Chicago office. Allen, who was formerly manager of the company's Chicago office, attended Pennsylvania State University. His Cleveland office will serve Ohio, Pennsylvania, Upper New York state, and eastern Michigan. Persson graduated from the University of Kansas. His Chicago office covers Indiana, Illinois, Kentucky, Missouri, Wisconsin and part of Michigan.

Tagliabue Corporation Names New Sales Representatives

C. J. Tagliabue Corporation (N. J.), wholly-owned subsidiary of Weston Electrical Instrument Corporation, has announced district sales representatives as follows: E. A. Thornwell, Inc., Atlanta, Ga.; Ranson, Wallace & Company, Charlotte, N. C.; Ambos-Jones Company, Cleveland, Ohio; Butler and Land, Dallas; Lynn Elliott Company, Houston; Curtis H. Stout, Little Rock, Ark.; Geeseka and Pinkney, Minneapolis; Joralemon, Craig & Company, Philadelphia; J. E. Redmond Supply Company, Phoenix, Ariz.; and, Riddle and Hubbell, Tulsa.

Reynolds Metals Appoints Tulsa Oil Industry Agent

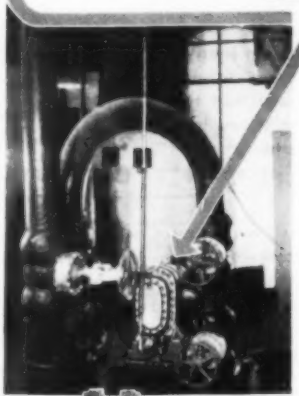
Reynolds Metals Company has appointed L. E. Pennington representative to the petroleum industry. His headquarters will be in Tulsa. Pennington has done metallurgical and engineering work for Henry Vogt Machine Company, Louisville Drying Machine Company and Reynolds Metals Company. After serving as plant metallurgist at one of the latter's extrusion plants and rod mill, he was transferred to the technical service department where he has served as technical advisor. He is also the author of a number of technical articles for metalworking magazines and a book entitled "Machining Aluminum Alloys."

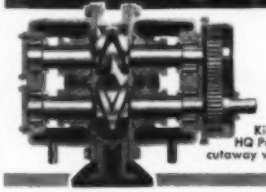
Graver Water Conditioning Moves Into New Gotham Quarters

Graver Water Conditioning Company, a division of Graver Tank & Manufacturing Company, Inc., has moved its general offices to larger quarters at 216 West 14 Street, New York 11. The new location houses expanded sales and engineering offices, a complete chemical laboratory and an extensive pilot plant.

The extended operations of the company provide "individualized and complete technical, chemical, engineering and manufacturing facilities, and an undivided responsibility for furnishing and

FOR DEPENDABLE HOT OIL PUMPING
INSTALL A KINNEY HQ





Kinney HQ Pump, cutaway view.

Way back in 1939, at the Stein Hall Company, Inc., Long Island City, the Parks Cramer Company installed a Kinney HQ 8 x 4 pump to circulate hot oil in the Merrill Process system. After years of service this pump continues to deliver 190 g.p.m. hot oil, supplying 1,600,000 BTU per hour.

You can depend on Kinney Rotary Pumps for handling hot industrial oils, and for oil refinery vacuum tower bottom service at high temperatures. Engineered for years of fast, trouble-free pumping, the Kinney HQ is always reliable on the job.

1. Low maintenance — automatic lubrication.
2. High pumping speed — positive displacement; continuous, non-pulsating flow.
3. Long life — unique helical rotors driven by hardened steel timing gears. Anti-friction bearings throughout.

Write for Bulletin L48

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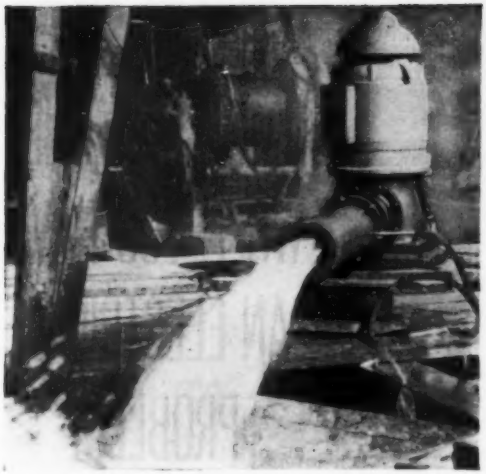

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COMPARISON is a fair yardstick in buying any well water system. That is why Layne welcomes and urges comparison with any and all other systems now being built. Comparisons quickly reveal the superiority of Layne designing as reflected by higher efficiency, better materials and low upkeep cost, plus rugged construction insuring longer life.

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When you buy a well water system it is wise and profitable to choose a Layne. Thousands of big, medium and small installations are giving economical and satisfactory service today and will continue to do so for many years.

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HOW AQUA-VACTORS PRODUCE VACUUM WITH WATER

CR Aqua-Vactor Uses Water as Motivating Fluid

Combining the advantages of the steam jet ejector and the low cost of water, the Croll-Reynolds AQUA-VACTOR is employed economically in many instances. Low in first cost and with no moving parts, the water jet may be used to mix liquids, serve both as an ejector and condenser, and in isolated cases, handle air and gases.

While not as efficient as a steam jet ejector, the AQUA-VACTOR becomes economical when the pressure of water is being dissipated for other process work. In such cases it may be possible to use the AQUA-VACTOR either as an ejector alone or as both an ejector and a condenser using water under pressure to operate the AQUA-VACTOR and using the exhaust from the AQUA-VACTOR for other processes.

The illustration shows a type of SW EVACTOR using steam in the first stage and water in the second stage. Here the AQUA-VACTOR is used both as an ejector and as a condenser, handling air and, at the same time, condensing steam from the first stage. Of interest to engineers with corrosion problems, the steam stage in the illustration is constructed of carbon including the steam nozzle. The carbon is incased in cast iron giving the equipment the strength of iron and the corrosion resistance of carbon.

For more complete information concerning the application of the AQUA-VACTOR, or any type of steam jet EVACTOR, write today to:

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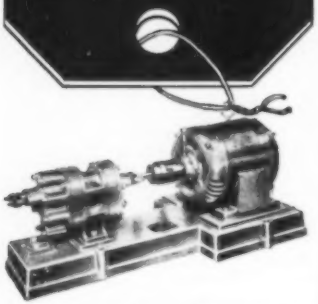

Sier-Bath Screw Pumps and Gearex Pumps are designed to do a job—and keep doing it. The manufacturer has a full appreciation of the high cost of interrupting the operation of a line to permit pump repairs. On the Internal Gear-type Screw Pump, for example, the gland is the only point of attention and as this is on the suction side, it is almost negligible. It is not unusual for the packing to last two years without repacking. The pressure on the gland is so slight that it is possible to add a new ring of packing without shutting down the unit. Send for information.

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erecting its equipment, including hot process softeners, deaerating heater, zeolite softeners, cation and anion exchangers, demineralizers, clarification and filtration apparatus, reactivators, and chemical feeders."

Joins Rockwell as Engineer

B. C. Walling has joined the Nordstrom Valve Division of Rockwell Manufacturing Company as a sales engineer. He will be located in Corpus Christi and will handle work in the oil fields formerly managed by R. J. Munn who has been transferred to another territory. Walling will work out of the company's Houston office under the direction of C. K. Madison, district manager.

Walling

Walling graduated from Southern Methodist University as a mechanical engineer, and spent two years in the Navy as a lieutenant junior grade. For the past three years he has been employed by Humble Oil & Refining Company as a petroleum engineer.

Peerless Pump Appoints Twist to Los Angeles Post

Food Machinery and Chemical Corporation has appointed Gerald F. Twist manager of the firm's Peerless Pump Division with headquarters in Los Angeles. Twist succeeds Francis F. Fairman, Jr., who is resuming his former association with General Electric Company.

Twist

Twist graduated from Stanford University School of Mechanical Engineering and later joined Food Machinery and Chemical Corporation's Anderson-Barngrover Division, producer of canning equipment. In 1947 he resigned as director and executive vice president of Atlas Imperial Diesel Engineer Company at Oakland, Calif., to take charge of Food Machinery and Chemical Corporation's corn harvester manufacturing operation in Indiana. In January of this year, he was named a vice president and manager of the firm's new subsidiary, Stokes and Smith Company of Philadelphia.

Bigelow-Liptak Announces New Insulation Products

A complete line of high temperature insulation products has been announced by Bigelow - Liptak Corporation. This marks the first time that the company has sold insulation separately. Included is a mineral wool all-purpose block which will be marketed in standard sizes. Called BL-17 for temperatures to 1700° F., it has a density of 1.67 pounds per board foot and is chemically inert. It is claimed not to disintegrate, cause rust or corrosion.

Also included is C-18, a companion product to the block. It is an insulating

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THEY'RE SINGLE SEATED. Annin Domotor Valves are of simple, single seat design. The valve seat, clamped in position between the two sections of the separable valve body, absorbs all line stresses in shear. There are no troublesome threads to cause distortion and leakage. No grinding-in operation is necessary. The smooth, curved contour of the flow passages reduces turbulence and pressure drop to a minimum, and provides greater flow capacity. Slurries, sludges and viscous fluids are effectively controlled through the elimination of pockets and shoulders that ordinarily accumulate solids.

THEY'RE EFFICIENT. Field proven, piston-type, Annin Domotor Valves provide smooth, positive control, accurate to .0005 in pressure impulse response. They will handle high velocity fluids at temperatures from −300°F to 1000°F and pressures to 2500 lbs. Simplified construction cuts valve body weight by over 50%. Down-time for maintenance is reduced to an absolute minimum.

THEY'RE VERSATILE. Annin Single Seat Domotor Valves have interchangeable line flanges. A single valve may be used anywhere in your plant regardless of system pressure. With the valve seat serving as a pivot, the two-piece valve body may be rotated in assembly to form a right-hand angle, left-hand angle or straight through pattern. The addition of a simple adapter provides an angle pattern valve. The separable valve construction provides fast, on-the-job inspection or replacement of the valve trim.

THEY'RE AVAILABLE IN A WIDE RANGE OF ALLOYS. Annin Single Seat Domotor Valves are offered in a wide range of alloys fo. effective control of corrosive, erosive or gaseous fluids under the most severe operating conditions. They are available in Cast Carbon Steel, Cast Type 316 Stainless, Annico 20 (D 20), Hasteloy B and C, Monel, Ampco 15, 98% "A" Nickel, Zinc Free Bronze and almost any castable alloy.

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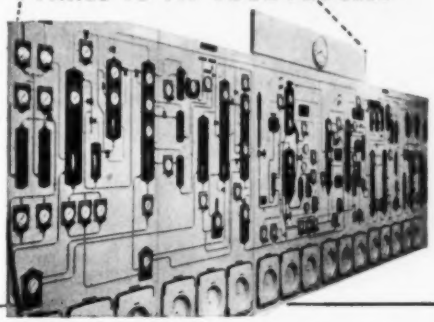

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cement composed of mineral wool, long fiber asbestos, and an adhesive binder and is applied like a plastic. Also marketed will be an insulating cement good to 2300 F., finishing cement, pipe covering, mineral wool blankets, loose fibrous and granulated mineral wool, protective coatings for insulation surfaces, and an insulation block adhesive.

Houston Firm to Represent Pittsburgh Coke Coatings

S. D. Day, head of the sales firm of S. D. Day Company, Houston, has been appointed southwest representative for Pittsburgh Coke & Chemical Company's protective coatings. Day pioneered in the early 1930's in the sale of coal tar pipe line enamels and related materials in Texas and on the west coast. He has handled work for United Gas Pipe Line Company in Texas and sold enamel for Southern Counties Gas Company line from Huntington Beach, Cal. to San Diego. Day was formerly with Barrett Company and more recently, was vice president in charge of southern sales for Pipe Line Service Corporation.

Day

Flexible Tubing Appoints Distributor Sales Manager

A. H. Loux has been appointed manager of distributor sales for Flexible Tubing Corporation, makers of spiratube flexible tubing. He will have the responsibility for the development of distributor sales, the acquisition of new distributors and the origination and recommendation of policies affecting manufacturer - distributor relations on products and accessories of the company.

Loux

Loux has been employed with Standard Oil Company of New York. During the war he was assistant district manager and chief of the production service department of the War Production Board. He joined Flexible Tubing Corporation, later becoming direct factory representative for northern New York and the adjacent territory.

Nooter Boiler Works Changes Corporate Name

John Nooter Boiler Works Company, steel and alloy plate fabricators since 1896, has adopted the name of Nooter Corporation. The company said that its scope of service has expanded so that it no longer includes just boiler works as the name implied. Under the new name there will be no change in management, personnel, policies or address.

The company, which began as a small job shop serving St. Louis, first manufactured horizontal return tubular boilers and then specialized in the manufacture of tanks and pressure vessels.

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Dr. N. W. Snyder Becomes Santa Fe Chief Consultant

Dr. N. W. Snyder, assistant professor of mechanical engineering at the University of California, has joined the staff of Santa Fe Tank and Tower Company, Los Angeles as chief technical consultant. Dr. Snyder will work in conjunction with L. Obert and A. M. Kuehmsted, veteran members of the engineering staff.

Snyder

In addition to extensive research on government war projects, Dr. Snyder has conducted numerous experiments on thermal radiation and heat transfer. He has been in charge of a cooling tower project sponsored by the American Society of Heating and Ventilating Engineers at the University of California. As an authority on problems of cooling and heat transfer, he will project many of his research findings into a new program planned by the Santa Fe Tank and Tower Company.

Three Join B & W Research

Hayden Jones, Jr., M. S. in chemical engineering from Iowa State College; Norman Phillips, B. S. in fuel technology from Pennsylvania State College, and Earle Young, Jr., B. S. in chemical engineering from Carnegie Institute of Technology, have recently been added to the Chemical Laboratory staff of the Research & Development Department of The Babcock & Wilcox Company in Alliance, Ohio.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 OF PETROLEUM REFINER, published monthly at Houston, Texas, for October 1, 1949.

State of Texas, County of Harris, ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the Business Manager of PETROLEUM REFINER and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ray L. Dudley, 3371 Chevy Chase, Houston, Texas; Editor, Ludlow S. Daniels, 1513 Chippendale, Houston, Texas; Managing Editor, Silas B. Hagedale, 1636 North Blvd., Houston, Texas, Business manager, A. L. Burns, No. 7 Chelsea Place, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; A. L. Burns, Houston, Texas; J. F. Carter, Jr., Tulsa, Okla.; Mrs. Mary Margaret Cashman, Houston, Texas; Mrs. Carolyn Dodson Dudley, San Angelo, Texas; Jane Wooden Dudley, Trustee for Miss Fredrica Lucinda Dudley, Houston, Texas; Ray L. Dudley, Independent Executor and Trustee of Estate of Dr. N. L. Dudley, Deceased, Houston, Texas; Ray L. Dudley, Houston, Texas; Wm. G. Dudley, Houston, Texas; Mrs. Libbie Rice Farish, Houston, Texas; Wm. V. Gross, Utopia, Texas; Mrs. Anita B. Lane, Houston, Texas; Chas. H. Lane, Houston, Texas; Tom W. Nelson, Houston, Texas; Mrs. Maude G. Sterling, Houston, Texas; O. R. Waller, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: M. D. Anderson Foundation, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has not reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS, Business Manager.

Sworn to and subscribed before me this 16th day of September, 1949.

P. J. AUCOIN.

(Seal) Notary Public in and for Harris County, Texas. (My commission expires June 1, 1951)

Wells Rejoins Graver Tank As Southern Area Manager

Lloyd K. Wells has rejoined Graver Tank & Manufacturing Company as a manager of the southern division of Graver Construction Company with headquarters at Houston. Wells resigned in 1946 because of ill health and became engaged in citrus raising in California. He studied civil engineering at Oklahoma A. & M. From 1925 to 1940, he was associated in many phases of refinery construction with The M. W. Kellogg Company and Alco Products-Transamerican Construction Company. From 1940 to 1946, he was manager of the Construction division of Graver Tank & Manufacturing Company, Inc.

Wells

Announces Staff Changes

Stanley Martin, vice president of Franklin Supply Company, Chicago, has been transferred to Mt. Pleasant, Mich. to handle company operations in Michigan and Ohio. Kenneth Goodell, appointed district manager has been transferred to East Chicago, Ind. Roy Wood, vice president, will be located in the Chicago handling company sales.

PETROLEUM REFINER CLASSIFIED ADS

RATES for Classified Ads are $8 per column inch. Minimum size one column inch. In smallest type size, figure 50 words per inch. Situations Wanted $4 per column inch. **All classified ads payable in advance.** Ten percent discount if three or more insertions are ordered at same time. COPY DEADLINE is 25th of month preceding date of issue. Send copy and checks to: Classified Ad Department, Petroleum Refiner, P. O. Box 2608, Houston 1, Texas.

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Wanted in Honolulu, Hawaii

Chemical or Process Engineer between 25 and 40 years of age with at least five years technical refinery experience and college degree or equivalent.

Operating Supervisors between 25 and 40 years of age with at least five years practical experience and two years of college or equivalent.

These positions are with a new petroleum refining company located in Honolulu.

If you are interested in these opportunities write, giving full particulars including education, experience, references, and salary expected. Address: Box 157R, c/o Petroleum Refiner, Houston, Texas.

Petroleum Service Engineer

Manufacturer of refinery processing materials has an opening for a Petroleum Chemist or Engineer for technical service to the petroleum industry.

The position will entail considerable traveling, primarily in the Gulf Coast area, doing field work with local representatives assisting them with their sales and product application in oil refineries.

Applicants must be 30 to 40 years of age, know chemical and mechanical processes and equipment and have experience in operating or refinery engineering.

Reply giving full details of education, experience and personal status to F. B. Johnston, Box 2 P. R., 117 Liberty Street, New York 6, N. Y.

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in this, the October, 1949, issue of

Petroleum Refiner

* The asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in The 1948 Refinery Catalog.

A

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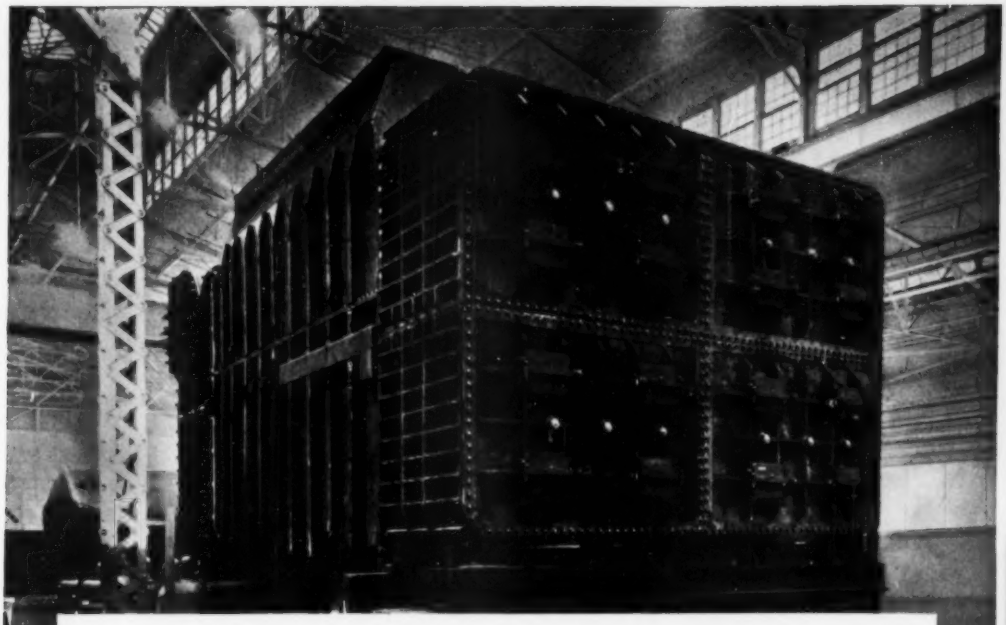

● 90,000 sq. ft. single pass surface condenser assembled for hydrostatic test in the factory of Ingersoll-Rand Company. The condenser will soon be put into operation serving a 150,000 kw turbo-generator in a large Midwest power plant. The condenser surface consists of approximately 16,360 Admiralty Metal tubes ⅝" O.D.—18-DWG having an overall length of 24' 2⅛". The total weight of tubes is 192,000 pounds, and their combined total length if laid end to end is approximately 396,400 ft. or 75 miles. Also, the tube sheets at each end of the condenser are drilled from Muntz Metal tube sheet blanks which weighed approximately 52,000 pounds, and brass bolts and nuts were used extensively in the condenser assembly.

Photo courtesy of Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

ELECTRICITY CAN BE CORROSIVE, TOO

OPERATORS of condensers are well-informed and follow sound general practices that should result in satisfactory tube life, but it has been estimated that in about 90% of American plants there is at least one piece of equipment that shows tube trouble. Such cases interest Revere greatly, because we want condenser tubes to give satisfactory, economical service.

Sometimes the causes of premature failure are obscure and difficult to discover. One of them is stray electricity. When you remember that copper plating is usually done at about 4 to 6 volts, you can see that it doesn't take much to move metal from one place to another through a fluid. Any flow of current through a condenser is sure to be destructive.

Electricity often finds strange routes to ground through high-resistance shorts that do not show up through blown fuses, overheated parts, arcing, and similar obvious indications. Pump motors, for example, may work perfectly well, but permit a little "corrosive" electricity to pass along to ground through the condenser; electrolysis results. Galvanic action, due to the use of metals of too-great dissimilarity, may also occur, but is rare in a condenser properly designed for its operating conditions.

So Revere suggests you include electricity as a possibility when seeking the causes of unexpected tube failure. And it is also advisable to save samples cut from failed tubes, to be sent to Revere for laboratory examination. Facts thus scientifically uncovered may lead to recommendations that will solve the problem. If you have a condenser tube problem, ask Revere to help.

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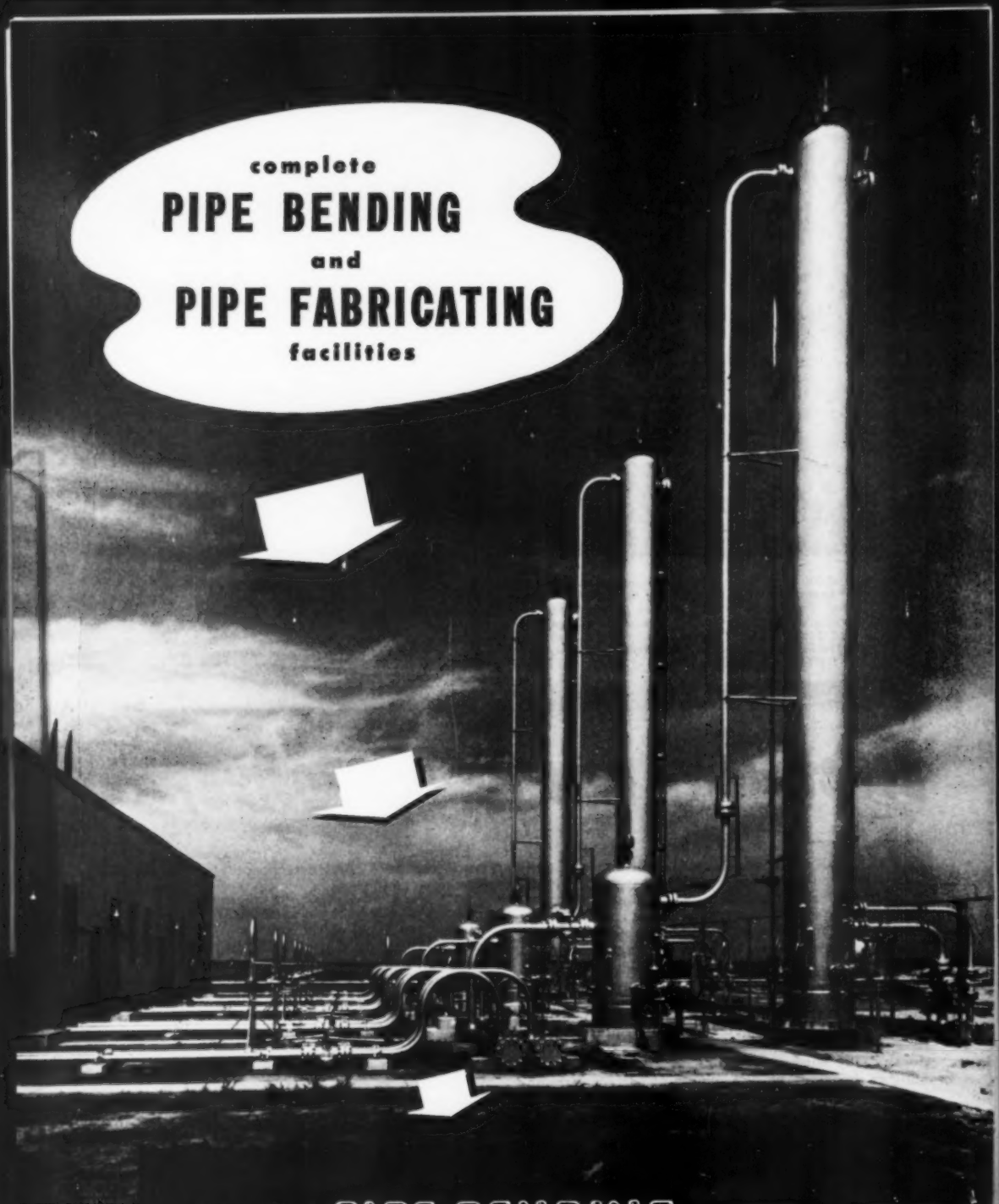

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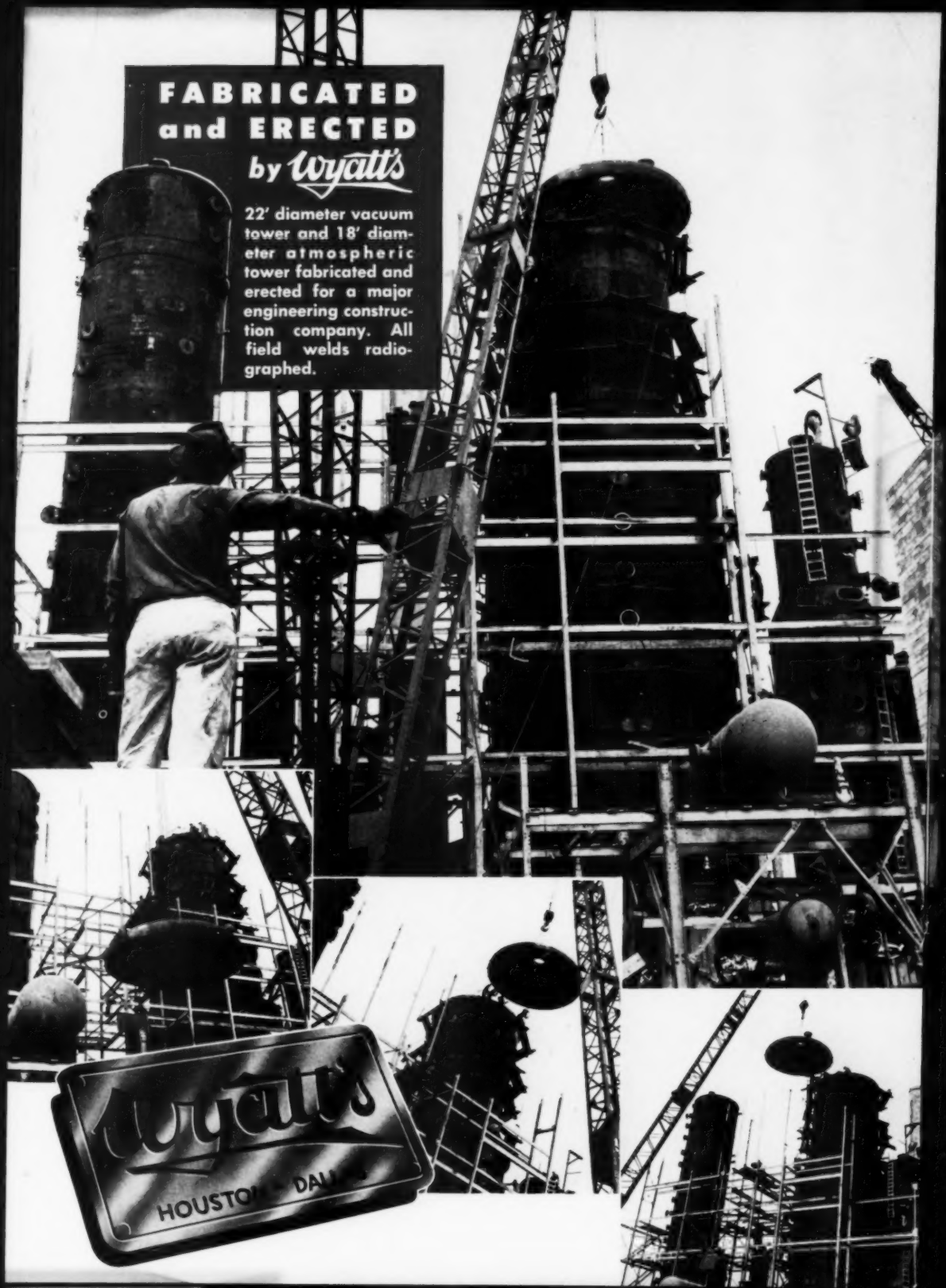
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Plate 956
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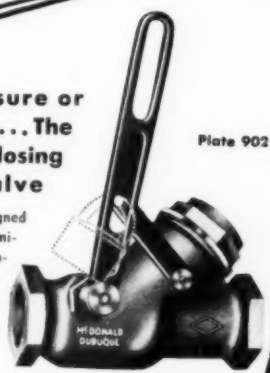

Plate 902

Plate 988

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